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ANNEX

BULLETIN UNIVERSITY OF MONTANA.
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Lectures at Flathead Lake

A Series of Lectures delivered at the University of Montana
Biological Station at Flathead Lake, by the Staff of Instructors,
Session of 1902.

University of Montana, Biological Station, Bigfork, Mont.,
Under Direction of Morton John Elrod.

University of Montana, Missoula, Montana, U. S. A.
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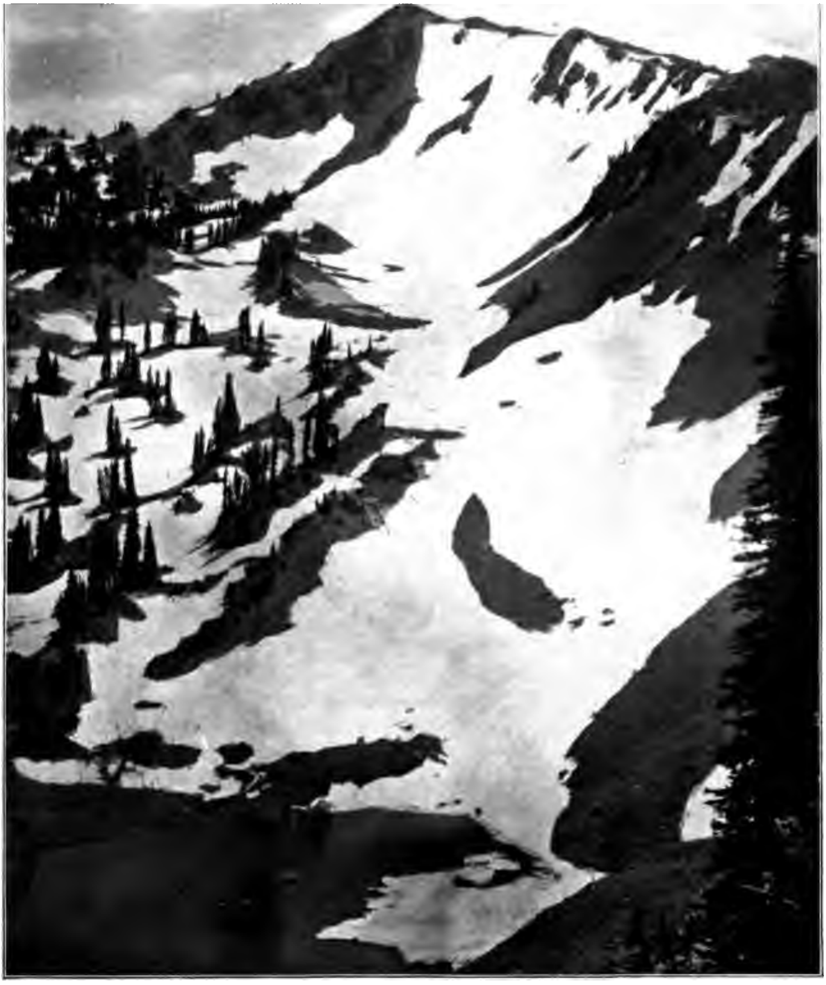

MacDougal Peak, Swan Range, from the ridge, showing snow field with ice. Note how the timber seeks the drier ridges. Photo by M. J. E., August, 1902. The view is south. Altitude of summit, 7725.

BULLETIN UNIVERSITY OF MONTANA.
No. 1~~6~~. 15
BIOLOGICAL SERIES No. 5.

Lectures at Flathead Lake

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A Series of Lectures delivered at the University of Montana Biological Station at Flathead Lake, by the Staff of Instructors, Session of 1902.

UNIVERSITY OF MONTANA, BIOLOGICAL STATION, BIGFORK, MONT.,
UNDER DIRECTION OF MORTON JOHN ELROD.

University of Montana, Missoula, Montana, U. S. A.
1903.

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LECTURERS AT THE UNIVERSITY OF MONTANA BIOLOGICAI STATION, 1902.

Morton John Elrod, Professor of Biology, University of Montana; Pr dent, Montana Academy of Sciences, Arts and Letters; Direc of the Station.

Harry Nichols Whitford, Assistant in Botany, University of Chica and Collaborator in Bureau of Forestry, United States Dep ment of Agriculture.

Perley Milton Silloway, Principal Fergus County, Montana, Free H School, Author of "Some Common Birds."

Maurice Ricker, Principal Burlington, Iowa, High School, Member Ic Academy of Science.

INTRODUCTION.

The material presented in this bulletin consists of a number of lectures or talks delivered at the University of Montana Biological Station in the summer of 1902, by the station staff. Not all the lectures are given. Many of the illustrations, such as photographs, charts, and drawings, have of necessity been omitted, owing to the expense of reproduction. The lectures on protective resemblance and mimicry were illustrated by numerous colored drawings and charts, the work of Mrs. Maurice Ricker. But few of these can be reproduced, and they only in black and white. While the absence of numerous illustrations is to be regretted, it is thought the material presented will be of sufficient aid to warrant publication.

The lectures are given for a double purpose.

1. They should be of great service to teachers of the state in nature-study work. Several are prepared expressly for this purpose. Some of those treating of particular features of the locality may by slight modification be made to apply to other localities. There has been an urgent demand for just such information as is here presented, and the publication of the lectures will answer many inquiries that have been received.

2. They will put before the people of the state some of the results of original work carried on at the station. This is all the more desirable since nearly all the observations in a new locality must for a time be new, and hence deeply interesting. It is hoped they will show in part the wide field open for research, and encourage the attendance of many who are seeking such a place for study.

Since the lectures or talks were delivered to audiences of whom many were unacquainted with the subject and with technical terms the simplest language has been used, thereby making them of greatest service.

M. J. E.

Missoula, Mont., April 27, 1903.

The Physiography of the Flathead Lake Region.

Morton John Elrod.

The first thing one must do in a new locality is to become familiar with 'the lay of the land.' The surface geography and geology of a region must first be understood if one is to seriously discuss the botanical or zoological life. The character of the soil determines to a large extent the general character of the vegetation, and the surface irregularities will indicate the nature of the zoological life. In a region where roads, fences, houses, and similar works of man are absent, a knowledge of the country is all the more important in order to get over the country. Since much of the country is as yet unexplored the physiography of the region will be especially interesting to those working at the station.

The views here given are based on the observations of the past four years. Later study may require that they be modified in part, but it is believed the observations will aid very much in working out the exact changes that have taken place in this section of the state. The glaciation of the region offers a good field for detailed work.

The Mission and Swan ranges of mountains, in northwestern Montana, lie parallel with each other, extending north and south in general direction. The Mission range is about seventy-five miles long, ending as a range at the Biological Station. The Swan range extends twenty-five or thirty miles farther north. Both ranges were made by faulting. The stronger throw was at the southern end of the ranges, where the high peaks, reaching 10,000 feet, are found. Between the two ranges the Swan river flows toward the north. It enters Swan lake, still between the ranges, far down the side. From Swan lake the river flows still northward for a few miles, then winds around with a big bend and turns westward through a new channel to its inlet into Flathead lake. That portion of the Swan range which extends north of the Mission range borders directly on the valley north of Flathead lake, rising abruptly from the plain, without foothills.

The formation of the ranges gave to the western side of each an abrupt and steep face, intersected with many ravines and canyons, with more gradual slopes on the eastern sides. The western base of the upper end of the Mission range is washed by Flathead lake, which for the greater portion of the distance meets the mountains with abruptness. There is little level or tillable land between, and often scarcely room for a wagon road.

South of Flathead lake a large valley, Mission valley, extends southward for thirty-five miles. North of the lake is another large valley which continues northward to the British boundary. On the western shore a spur range of the Kootenais shuts in the waters of the lake. The outlet of the lake is through a new channel, with a series of rapids, a foaming river of wondrous beauty, untouched by man's intervention, with only a trail along the bank and an occasional Indian path to the water's edge for fishing purposes. The lake is about thirty miles long. At its widest portion it is perhaps seventeen to nineteen miles. For the greater portion the width is no more than eight or ten miles.

Two rivers enter Flathead lake. Flathead river flows into the northern end near the center. Swan or Bigfork river flows into the northeast corner, past the site of the laboratory. See Fig. 4. Flathead is much the larger of the two, has a much larger drainage area, and carries into the lake much more sediment. The delta made by the river extends into the lake for more than a mile. Beyond this the lake drops off abruptly to deep water.

The preceding brief statements give the skeleton of the region to be covered in the work of the future, of which the present lecture is the smallest part. Let us consider briefly the agencies that have been at work in remodelling the surface, with the results as revealed by a rather superficial study.

When the mountain ranges were first upheaved their faces were abrupt and perpendicular. The valleys were deep and angular troughs between the ranges, rather than level valleys. It is believed that Flathead lake and the valleys to the north and south were formed by a slip in the faulting process, by which the western portion fell, leaving the mountain ranges as an abrupt border for a comparatively level plain. Evidence for this may be seen in the numerous photographs taken in the two ranges, which show plainly the stratification of the rocks, their slope and dip, and the configuration of the mountain range.

Immediately after this upheaval various agencies began the work of tearing down the ranges, and fashioning them and the valleys into their present forms. The agencies at work have been the wind and air, water, frost and ice, and the vegetation. Vegetation, as also animals, was absent at first, and came gradually, after the disintegration had been sufficient to afford a foothold.

The process of disintegration has continued from the first to the present, and continues now. It will continue until the entire mountain ranges are levelled. The rocks were alternately hot and cold, wet and dry. The small crevices were filled with snow and ice, which made them larger. Larger and larger they became, until pieces, large and small, tumbled from the face of the cliffs. Disintegration was slow or fast according to the nature of the rock. The smaller portions were washed down into the troughs between ranges, filling them up. While the larger channels between ranges were filling up the smaller gorges and ravines at right angles to these and between peaks were being ploughed deeper and smoother by the melting snows from above. The summits were being penetrated by the percolating waters, and the entire mass in some cases rent in pieces by the expanding ice. In some cases the faces of the cliffs fell away until the entire mountain tops fell, leaving the present summits a mass of boulders, still being slowly worn away by the wind and water. This is evidently the case with McDonald peak of the Mission range, as may be seen by the photographs taken at the western summit.

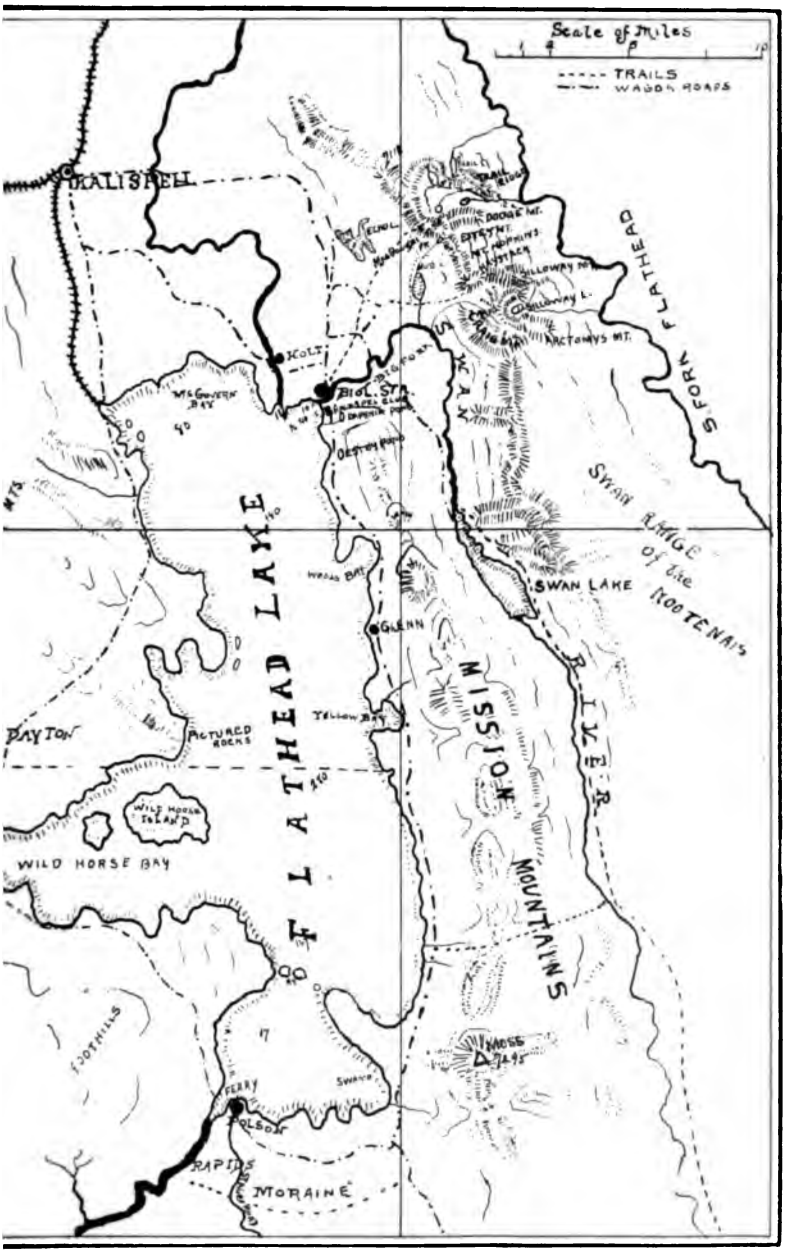

FIG. 4. Map of Flathead Lake and adjacent region.

Lichens were probably the first forms of vegetable life to appear. These probably aided in the process of rock disintegration. As lichens apparently secure the greater part of their nourishment from symbiotic algae growing within their tissue they could and did thrive. Their decaying tissues formed the first vegetable loam which could support the higher forms of life. As other forms of vegetation appeared in succession the soil and rocks were held more firmly in place, making the tearing down process very much slower.

In later times came the ice age. The whole region was covered with a mantle of ice. How deep the river was is mere speculation. From the country adjacent to the laboratory which has been swept by it the depth was many hundreds of feet. At the lower end of Flathead lake a huge dam 450 feet high was left by the ice. At this time the lake was several hundred feet deeper than at present, and covered much of the northern valley, flooding the land on which the laboratory now stands.

How many advances and retreats of the ice mass covered the valley must be determined by more extended study, and by one more competent than I. Whether the main glacial mass was local or continental must be determined by others. From a careful study of the region I can give only the results as evidenced by glacial action.

During the glacial period large masses of ice no doubt slid down the steep mountain slopes into the wider ravines and valleys below, in the same manner as ice masses on mountain tops at the present time. These glaciers flowed into one large glacier whose movement was occasioned for the most part by the pressure from behind. The present valley of the Swan river was filled with ice whose movement was northward. At the same time a much larger ice mass was crossing the wide lake valley from the north. I am not able to say whether the ice mass slid over the frozen lake or whether it aided in gouging out a deeper bed. I am inclined to the former view.

This will be better understood from a study of the map of the region, Fig. 4. The first ice river had a direction represented by the present bed of Swan river. The second and larger ice mass had a direction across Flathead lake from north to south. At the low end of the Mission range these two forces met. The larger turned the smaller first at a right angle, then back on its course, but on the opposite side of the Mission range. On the ground in the immediate vicinity of this laboratory this meeting took place. It must have been a grand sight could it have been witnessed.

Also consult Fig. 5, which is a photograph from the summit of MacDougal peak in the Swan range. The Swan river ice flow came down from the left in the picture. The main flow was from the right. They met in the middle foreground. The lower summits immediately in front of the lake toward the observer were ground over by the ice mass.

On the summits southeast of the Biological Station, which may easily be visited, large boulders, weighing many tons, lie stranded. They are well marked with glacial grooves, and are silent witnesses of the great force which must have been used in their transportation. On some of the summits where the rock strata are undisturbed may be seen deep and

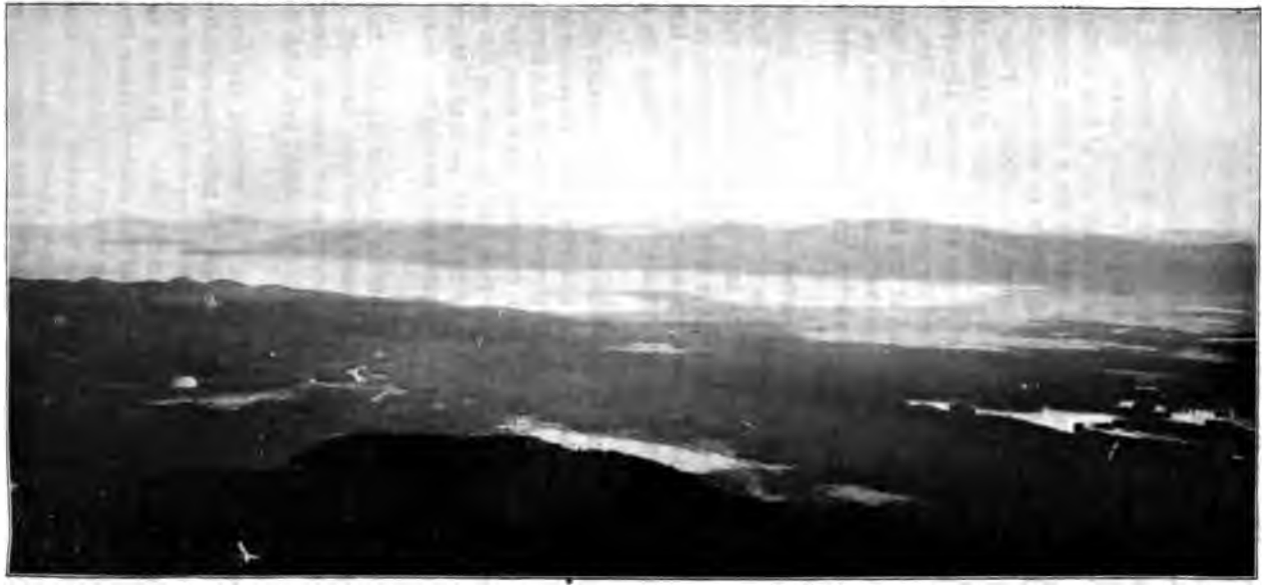

FIG. 5. General view westward from the summit of MacDougal Peak. In the foreground is the wooded plain. Echo Lake is on the right, Rost Lake in the middle foreground, Swan River on the left. In the distance is Flathead Lake. The point of land extending into the lake is the delta of Flathead River. Photo by M. J. E.

perfectly plain grooves in the rocks, showing plainly the direction of the ice movement. Also, on the east is the rounded surface made as the ice was forced upward, and on the west is the jagged cliff, unaffected by the ice as it broke off and tumbled over.

The larger ice mass extended across the Mission valley, pushed over the hills south of St. Ignatius Mission, where it left stranded boulders high on the summits, and on past Arlee to the Cabinet range. Whether it passed over or through these mountains I cannot say at this writing. The southern end of the Mission valley is marked by a high moraine. Its exact height has not been determined, but it is several hundred feet. This moraine is much broken, with many inequalities. From this region to the second moraine at the foot of Flathead lake is about thirty-five miles. This territory shows many evidences of glaciation, stranded boulders, hundreds of potholes, banks of pebbly nature, and the like.

As stated previously, the moraine at the foot of Flathead lake is 450 feet above the lake. It extends from the Mission mountains on the east to the Cabinets on the west. Its location may readily be seen by consulting the map again, Figure 4.

At the time this was made the outlet of the lake was through the arm at Wild Horse bay, and through the present Little Bitter Root river. An unusual amount of water caused the lake to rise unusually high, when it overflowed the moraine. The cutting was rapid, resulting in a lower lake level and a new outlet. The terraces at both ends of the lake show the successive levels of the lake at different times. There are at least three, and possibly four.*

The partial drainage of the lake laid bare a large stretch of country to the north, much of which was flat and swampy. It seems apparent that the Swan river flowed northward along the base of the Swan range, and close to the range, emptying into Flathead river near the present town of Columbia Falls. Evidence for this may be seen in the partially filled swamp lakes, while a distinct old bed may be traced through the timber for the greater distance, a veritable bog swamp for most of the season.

By some unknown means, most likely an unusual ice flow from MacDougal peak, 7,725 feet high, the river must have been dammed, causing a temporary lake. The overflow was across a low pass by short cut to Flathead lake, resulting in a new channel, the present bed, with its beautiful rapids and cascades.

In the earlier time Flathead river must have entered the lake immediately after leaving the mountains. When the lake was partially drained by the overflow of the moraine at the southern end the river meandered over the level mud plain until it found the lake. It cut a very tortuous channel for the greater distance, and has changed many times. In a distance of fifteen miles the river course covers thirty miles.

By the recession of the main ice sheet northward a large amount of morainal material was deposited in the valley, showing most plainly in a line north of the end of the Mission range. This line of morainal material

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* This view is confirmed by Eliot Blackwelder, from the University of Chcago, who visited the region in 1902.

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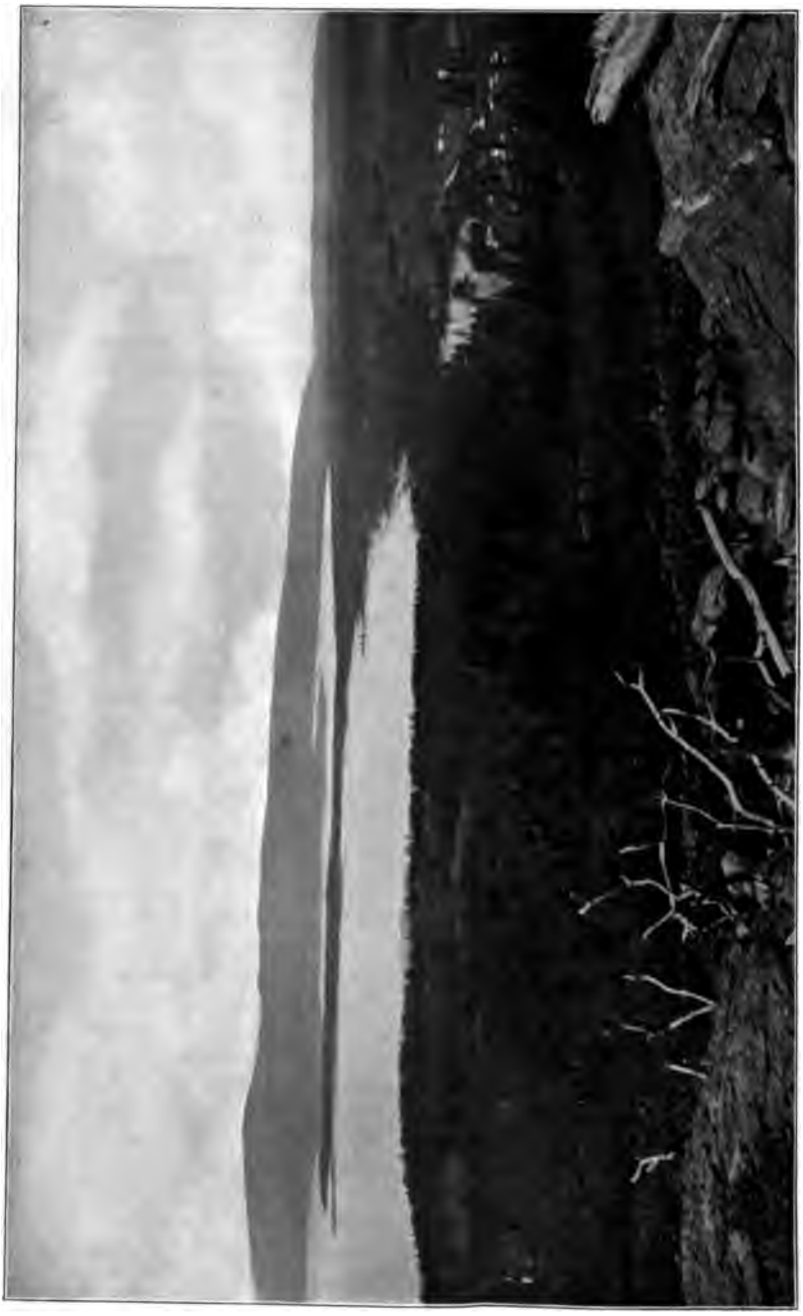

Upper end of Flathead lake, and valley, from Prospect hill. The tongue of land is the delta of Flathead river. Swan river is on the right, entrance to lake hidden by the forest. The laboratory is on the right bank of the river, the tents showing. The view is almost west. Photo. by M. J. E.

caused the waters of Swan river to be hemmed in between the Swan range and this glacial matter. When the river made its new channel to the westward the old channel was abandoned and soon filled up, owing to the fact that it had little fall, and was probably surrounded by dense forests such as now cover the region. A number of deeper places still hold water, forming some of the lakes in that region. The nearest of these to Swan river is Rost lake, which is less than two miles from the river. Next is Echo lake, north and west. It is quite certain that Echo lake was not a portion of the old river bed, but was formed by glacial action. Still farther north is Blaine lake, not yet visited, but lying in the old river valley.

Rost lake is nine miles distant from the laboratory northeast. It is about a mile long and less than ten feet deep in the deepest portion. In most places the water is less than three feet deep. It is bordered by dense forests, and is a dead lake, which in a short time will be a peat bog similar to many other swamps in the region.

Echo lake lies north and a little east of the laboratory. It is a land locked lake, with no surface outlet. Notwithstanding this it has several species of fish. Its outlet is underground through glacial drift, coming to the surface through large springs whose waters flow into Flathead river. The surface of Echo lake is quite unstable, and is likely to rise or fall any season. The lake has had very little study.

Swan lake has previously been mentioned. It is reached by wagon roads from the laboratory, the shortest being about eight miles long, the other about fourteen. Swan lake for the greater portion of its length is but an expansion of the river, hemmed in between the Swan and Mission ranges. Its location may be understood by an examination of the map, Fig. 4. This map is incorrect in part, as the upper end of the lake widens into a circular bay some two miles broad, bordered on the south by a large swamp. This swamp is covered densely with vegetation, and gradually gives way to grassy meadows, which in turn are bordered by dense forests.

The delta of Flathead river (Plate XLVIII) is worthy of extensive study, and is a good illustration of the method of filling up by sediment from a river. Very little sediment has been deposited by Swan river as compared with the Flathead. This is to be expected, since the former carries much less water than the latter. But the difference is very marked.

West of Flathead lake nothing has been done, and consequently little can be said concerning its physiography. This hasty and superficial view of the region will give those at the station an idea of the country in general, and will suggest more detailed study in many lines. There is still much to be done. The higher slopes of the Mission and Swan ranges have had very limited study. There are many lakes not yet visited. Much is left for the work of the future.

How to Study a Bird.

NATURE-STUDY LESSON.

Perley Milton Silloway.

The prime object of nature-study is the training of the powers of observation in such a manner that they shall minister to the higher intellectual faculties. It is not an end, but a means, whereby the observer obtains a stronger grasp upon the larger relations of life. Nature-study does not consider the probable destiny of the pupil as a botanist or a zoologist, but as a student of life in any or all of its relations, assuming that all Nature is simply environment which is to react upon the mind and develop its noblest faculties. Life is everywhere about us, and nature-study aims to teach anyone to see, hear, and appreciate that life, whether manifested in animal or plant. Hence the essential method of studying a bird is to cause anyone to see, hear, and appreciate the bird, and to consider its relationships as a part of the vast domain of Nature.

The primary step in the study of a bird is identification. The bird must be recognized, and to make recognition successful the object must be seen under circumstances which admit of definite observation. If the bird is a new one, a rapid inventory of the essential features of its description must be taken, and a fair idea gained of its size, form, color, and markings. The idea of size may be comparative, as somewhat larger than a chipping sparrow and smaller than a robin, or about as large as a pigeon. Attention must be given to the bird's form, or the general outline of the body. It may have elongated neck and short legs, like the geese; it may have both long neck and long legs, like the herons and cranes; it may be rather stoutly built, like most of the sparrows; or it may have a comparatively large head, like the flycatchers.

The prevailing colors must be noted, as general color of the upper parts, lower parts, head, wings, and tail. Then any striking markings should be carefully observed, as these markings are generally the quickest and surest means of identification. For instance, suppose we see a bird of black plumage, somewhat smaller than the robin, rather stoutly built, with prominent white bar on the wing. Upon reference to our book of descriptions, we learn that our new acquaintance is the lark bunting. Suppose we meet a blackbird, somewhat larger than our common friend of the feed-lot, with prominent yellow and white markings; we easily learn that our new friend is the yellow-headed blackbird. All these features in the foregoing descriptions should be promptly jotted down in a note-book, to be used when a key can be consulted.

The actions of the bird at the time of observation are especially important, for they often serve as a key to the family or group to which the bird under observation belongs. There are peculiar characteristics of certain groups of birds, as the flirting of the tail by the smaller flycatchers, the deliberate folding of the wings by the plovers upon alighting, the teetering of the body by the smaller sandpipers when standing or walking, and similar actions which will occur to your own mind.

The special appearance of any bird is a great help in recognizing or identifying it. It may assume some characteristic attitude that will have a likeness to pictures we have seen or may see, and thus we are aided in determining the name of the bird. Suppose we are collecting on the shore of Daphnia pond. Among the rushes we see (though it will take sharp eyes to see it) a slender, brownish bird of rather large size, with elongated neck and head pointed upward in meditative attitude. We remember that we have read of the bitterns assuming this posture, and we form an idea which readily aids in identification,.

In connection with the description and appearance of the bird we are studying, we should learn to note its movements that seem to characterize the species. The kingbird and other flycatchers will be seen to leave their perch, fly outward and upward irregularly, try to capture a passing insect, turn in air, and quickly alight upon the same or another convenient perch. The sparrow hawk will often hover in air, maintain its place by continued fluttering of the wings, and then swoop down upon its prey, or else continue its quartering flight. We notice a bird somewhat larger than the robin, with enlarged head and noticeable crest. It flies over the water with harsh rattling cry, hovers in mid-air to select a victim in the water below, and then dives head foremost. By these actions we have little difficulty in recognizing the familiar kingfisher. A small bird, not so large as the chipping sparrow, alights upon the trunk of a tree near us, and begins to ascend the bole by a zig-zag course, inspecting the crevices of the bark for lurking insect larvae. These movements aid us in identifying the little brown creeper.

Besides what we have mentioned of movements of the bird as one of a species, it is especially interesting to note what may be called the individual actions of the bird. This constitutes a higher phase of bird study than that mentioned in the preceding paragraph, but it is productive of greater results. It separates the bird in question from its group, and regards it as an individual, manifesting traits for which it alone is responsible. No other bird of the same species may go through exactly the same performance, nor exhibit its impulses of love or hate, courage or fear, anger or pleasure, in just the same manner. It is this phase of bird study that marks such naturalists as Ernest Seton Thompson, John Burroughs, Bradford Torrey, Florence Merriam Bailey, and a few others.

Early in the study of a bird the observer must become familiar with its song, call-notes, or cries. Color is generally difficult to distinguish at any distance from which ordinary observation is made, hence the voice of the bird is the means most useful to the observer in recognizing his feathered friends. In the mating and early nesting season, the songs of the birds are especially attractive, and at that time the music should be so associated with identification that thereafter the song will suggest the author. However, the song season is comparatively short, ending in early July at its longest, with the exceptions of the song sparrow, the meadow lark, winter wren, the vireos, and a few others. Hence the calls and cries of the birds should be learned if one's observations are to be extended throughout the year. Indeed, in late July and during August, few birds are seen, as then they are strangely silent and it is only by their few calls that their presence can be detected. Many birds which haunt the bush allow only an occasional glimpse of them as they flit through their leafy retreats; such birds must be recognized chiefly by their calls. Others, like the rails, skulk among the reeds of the swamp, and the observer must know their voices if he attempts to note their presence.

The manner of flight soon becomes a matter of importance in our study of the bird. The skimming, darting, ceaseless flight of the swallows is vastly different from the whirring wing-movements of the grouse. The low, undulating flight of the sparrows is altogether a different movement from the flitting, capricious, restless evolutions of the terns and gulls. The hawks and eagles flap and soar overhead in ever-widening circles which carry them cloud-ward; the longspurs mount upward in irregular, progressive gradations, and then descend with outspread, unmoving wings, parachute-like, singing as they descend. Our friend robin speeds through the air from point to point in a straight-away course, while the catbird flits from bush to bush with labored action and flipping tail. The flight is so characteristic that it becomes an important aid to bird recognition.

If one is to know much about a bird, he should know where to look for it. To study the bittern one must go to the reedy bog. For the sandpipers we must look along the sandy shore of lake, river, or pond. The song sparrow chooses the bushes bordering the water, while the vesper sparrow resorts to meadows rank with grass. The redstart hides the beauty of its black and orange-red plumage in the depths of the swamp-woods; the meadowlark scatters its ringing melody over the open fields and meadows. Audubon's warbler revels in the depths of the high coniferous woods; the vireos chant in the lower story of the deciduous trees. The American dipper loves the vicinity of splashing falls and foaming rapids of the mountain streams; the handsome lazuli bunting prefers the edges of clearings or the telephone wires of the roadsides. Thus we see that each species has its characteristic haunts, and a knowledge of these haunts is an essential part of our study of the bird.

The migrations of a bird, the time of its arrival in a neighborhood if it is not a resident, and its departure, form a leading part of one's knowledge of the birds of any locality. Many birds can be studied only while they are loitering in a neighborhood a few days in spring or fall as they journey northward or southward in their seasonal movements. The date on which any species is seen, whether an old friend or a new acquaintance, is worthy of permanent record. When to look for a bird is as valuable knowledge as where to look for it, or how it looks. The notes regarding the time of occurrence of any bird in one's neighborhood will form a series of observations which in time may be collated into definite information of the bird's local and seasonal movements.

The study of a bird really becomes an investigation of its relationships of environment. The most important of these relationships, from an economic point of view, is the food of any species, a phase of study which opens an almost limitless field for investigation. What a bird eats is information of practical value to the rancher and horticulturist,—not what a bird eats at some particular season, but what constitutes its bill of fare for the entire period of its sojourn in the locality. Many of the birds are invaluable assistants of the agriculturist. Frank M. Chapman mentions a cuckoo whose stomach at six o'clock in the morning contained the remnants of forty-three tent caterpillars. It was found that four chickadees had eaten 1,028 eggs of the cankerworm, and four others had eaten 600 eggs and 105 female moths of the same noxious insect.

Many ranchers regard the hawks as their enemies, because they are reputed to catch up an occasional young chicken. With the exceptions of Cooper's hawk, the sharp-shinned hawk, and the goshawk, in this region, this belief is quite erroneous. It has been ascertained that 90 per cent of the food of the so-called "chicken hawks" consists of injurious rodents and vermin. A single owl in two hundred meals was known to eat 450 destructive mice and similar vermin. The great horned owl is perhaps the only exception among the nocturnal rapacious birds. Instead of killing the hawks and owls indiscriminately, it would be wiser for the rancher to raise a few additional chickens for the use of his feathered allies. The horticulturist can easily afford to plant a few extra trees to supply the fruit-eating propensities of some of the birds, which live chiefly on insect food during the remainder of the year. When any known bird is seen to capture an insect under circumstances such that the prey can be recognized, or when the bird is observed eating vegetable food, a note should be made of the fact, and as continued observations are made a fair estimate may be computed of the economic value of the species.

The manner of the bird's taking its food furnishes an interesting subject of study. The flycatchers capture their prey a-wing, flying outward from some post of observation, snapping down upon a flying insect, and returning to their perch. The chickadee gleans from the crevices of the bark along the branches, finding insects and larvae that other birds have overlooked. The robin uncovers the worms lurking near the surface of the soil, or finds the destructive larvae burrowing in the roots of the grass-tufts, or else boldly visits the garden and helps himself to the ripening fruit. The osprey wheels above the lake or river, hovers in air when he spies a likely victim below, dives flatwise into the water, and emerges with his finny prey. The swallows flit in rapid evolutions, seemingly on tireless wing, in quest of flying insects, and seldom taking their prey in any other manner. The manner of feeding is quite characteristic, hence it serves as an important aid in identification, besides offering the student a subject for many valuable notes.

The bird's relation to man, in the matter of companionship or association, suggests itself as worthy of consideration. The robin is known to nest in the door-yard; the raven seeks some inaccessible cliff to rear its brood, and at other seasons it invariably shuns the presence of man. There is a noticeable difference in the dispositions of the representatives of different species, and even of different individuals of the same species in different localities, to confide in the associations of civilization. The bird student will note these differences of disposition whenever they occur to him, and make them a part of his information regarding any bird of his neighborhood.

Furthermore, the disposition of any bird regarding its companions soon becomes very manifest to the observer. He will not see the kingbird many times before its pugnacious spirit exhibits itself in sundry encounters with other residents of its domain or with unwelcome visitors to its neighborhood. No other bird ventures near the home of the humming-bird without quickly arousing the anger of the tiny owner, and the intruder is speedily reminded that he is a trespasser. Quite in contrast to these, the good-natured osprey allows the blackbirds and swallows to nest in the cavities of its bulky habitation. Some interesting scenes of bird-life are brought to the notice of the observer who looks for these incidents of the bird's associations with its neighbors. They are the real key to the inner life of the neighborhood in avian circles, and a part of that higher phase of bird-study of which we have already spoken.

In considering the relationship of the bird with others of its own species, we find that the mating affords a series of profitable and sometimes amusing incidents. More individual character is manifested at this period than at any other, and for obvious reasons the bird disregards much of its ordinary dislike of observation, frequently placing itself in situations where its actions can be easily watched. Most of the traits usually denominated as human are then displayed, jealousy and gallantry characterizing the males, while constancy and modest coyness are noticeable in the conduct of the fairer sex.

The courting and mating among some of the grouse is an instance of the amusing scenes at this season in birdland. The males congregate at a convenient place in the neighborhood, go through a series of struttings, with inflated necks and drooping, quivering wings, apparently displaying all the accomplishments of form and movement at their command, after which the most successful competitor takes the lady of his choice and the couple begin housekeeping at once.

Careful attention to the singing of any bird will disclose the fact that any performer has a variety of musical numbers in his repertoire. Our mountain song sparrow has at least half a dozen separate songs at his command, and I have known the same male to sing as many as eight different arrangements of his notes. The western meadowlark has from six to eight different songs, and with all the variations of the different songsters of this species, it is likely that twenty to thirty varying meadowlark songs could be formulated. The same song will be uttered several times, then a variation will follow for several renditions, and thus change after change may be noted. In the singing there is manifested the same individuality as in other phases of the bird's activities, so that it is possible for the attentive bird-student to identify particular birds in the neighborhood by the execution of their songs.

The nest-building of the bird, its home-keeping, and other domestic affairs, constitute the most interesting period of its annual round to young observers. Volumes have been written about the nesting time, as at that season the study of the bird presents its most fascinating side. Children are usually so interested in the nests, eggs, and young that the safety of the nest is imperiled. The teacher should make a collection of old nests in the fall, or lead the children to bring them in, studying the sites and surroundings, and thus sustaining an interest aroused when the birds were using their habitations in the earlier season. The history of the young in the nest has come to be a vital part of the study of the bird. If properly directed, children will be deeply fascinated in oberving the events which mark the rearing of a brood of young birds in their nest.

The study of a bird implies that the bird itself should be the subject of study, primarily a-field. The interest of the pupil may be stimulated until many common birds, at first unknown, will be observed, identified by the teacher's aid and by colored plates or descriptions, studied as a part of the neighborhood's wealth of wild-life, and thus a zeal for bird study aroused that will cause the observer to become a life-long friend of the birds. A bird may be observed by one of the pupils, or may be familiar to only one, but the knowledge of this one may serve as the teacher's means to introduce the bird to the entire school. Little by little the acquaintance is extended, until all become friends of the bird. Meanwhile others are brought to notice, and in a comparatively short time the majority of the pupils have established friendly relations with all the common birds of the locality. If any accessible literature concerning bird-life has been brought before the children, not only has Nature's door been opened to them, but they have made a step into the realm of literature, from which none of them will voluntarily turn back.

Introduction to Studies on the Fertilization of Plants.

Maurice Ricker.

The subject of fertilization in plants is introduced by a consideration of the life history of an oak. This tree is usually well known, as a tree. Some have shown surprise that it has a flower and thus I am able to obtain the interest and attention, so necessary in the treatment of a nature study subject To go to the complex forms of adaptation at one bound would fail to give those who are wholly without botanical training the necessary insight into the anatomy and physiology of flowering plants. This treatise is an attempt to put this necessary information into words of one syllable, as it were.

Let us begin the study of an oak with the beginning of the plant, not as a separate individual, but with the formation of the mother cell which is afterwards to give rise to the plant. Brown and Mohl about 1840 showed that all organs were traceable to the one cell from which all the others are formed. During the past fifteen years some of the foremost biologists have devoted much time to the study of the cell. They have written many volumes and worked out many interesting things, even to some interesting studies of the difficult problem of inheritance. But we shall have little time for the consideration of their conclusions. It will suffice for our present purposes to restate the proposition of the ancients, "Like produces like." A black oak tree originated from an acorn borne upon a black oak tree. Of course the exception, so firmly believed in by all small boys, of the snake being produced from the horse hair, has to be dealt with. True the boy has not proved this by his own experiment. The one he tried was planted in the wrong time of the moon or in the wrong kind of a bottle, but he always knows some one who did grow a true snake from a horse hair.

Aristotle taught that life originated from ocean slime. He was unable to find proof of any material change in species. The last great pre-Darwinian battle was fought in the debate in Paris between St.Hilaire and Cuvier less than a week before the revolution of 1830. Cuvier won, at this time, by stating authoritively that skeletons show no change in form, even of the cats buried 3,000 years before, with mummies in Egypt. He overlooked the fact that conditions of environment which might lead to change in structure had remained constant likewise during the same length of time. We may defer the discussion of change and state that black oaks come from black oaks, white oaks from white oaks, burr oaks from burr oaks—let us see how.

We readily find the small yearling oaks under the parent tree. On pulling them up we find the well known acorn. We know this acorn grew upon the tree above. If it is spring-time we find no ripened acorns on the living limbs, but the dead branches broken by late summer winds give the proof, if any is needed.

Closer observation of the black oak reveals the little miniature acorns on the previous year's growth, in the axils of the leaves. It would require little reflection to see that these are the acorns to ripen in the fall.

In similar positions on the fresh young shoots of this spring's growth, in the axils of young leaves, may be found corresponding structures one year younger. The fleshy growth with the three reflected lips is the female flower. But 'what a flower!' I exclaimed, when I first saw it. It is devoid of the showy envelope which we associate with this word. A perfect flower is one that has both pistils and stamens; that of the oak has a pistil only, or anthers only. It is therefore an imperfect flower. A flower with both pistils and stamens and both whorls of the floral envelope—the outer one, the calyx and the inner, the corolla—is called a complete flower. Such is the apple blossom.

The sticky surfaces of the three lips are the stigmatic surfaces and the part bearing them—the stigma. The swollen attached end is the ovary. The stem connecting the stigma with the ovary, in this case quite short, is the style.

Sections of the ovary show that the exterior part is a covering for the seed like ovule. By proper methods we could go further and demonstrate the germ cell itself which is in reality the center of life and the cell from which the future oak is to spring.

Near the attached end of the ovule is a small opening into the ovule called the micropyle. By the provisions of nature no plant germ cell can divide and grow into an embryo without the introduction through this micropyle of the growing pollen tube. This pollen tube can grow only when a ripened grain of pollen produced on the anther of the same or another flower, falls upon the stigmatic surface of the pistil when it is in a receptive state. The conditions under which fertilization takes place, for this is the name given to the process just described, form an interesting chapter in plant morphology and plant physiology.

It is my purpose to call your attention to some of the wonderful adaptations in plants and animals which are evidently solely for the purpose of transferring the ripened pollen to the receptive stigmatic surface.

Let us take up the case of the oak. As was stated, the fruit bearing oak is imperfect, and consists of a pistil only. We must look for another flower,. therefore, which shall contain the stamens,. We call the pistil just examined the pistillate flower,. Let us look for the stamens or the staminate flower. In some cases we must look on another plant. When pistillate and staminate flowers are found on separate plants we have a dioecious plant. In the black oak we find the staminate flowers on the preceding year's growth in the axils of leaves. Such flowers are called monoecious.

If you examine the long catkins or aments it will be found that the stamens are borne upon a long stalk. When viewed through a lens a beautiful structure is disclosed. Each stem bears numerous flowers and each flower contains four stamens.

The drawing (Fig. 6) shows the anther on the pollen bearing part,

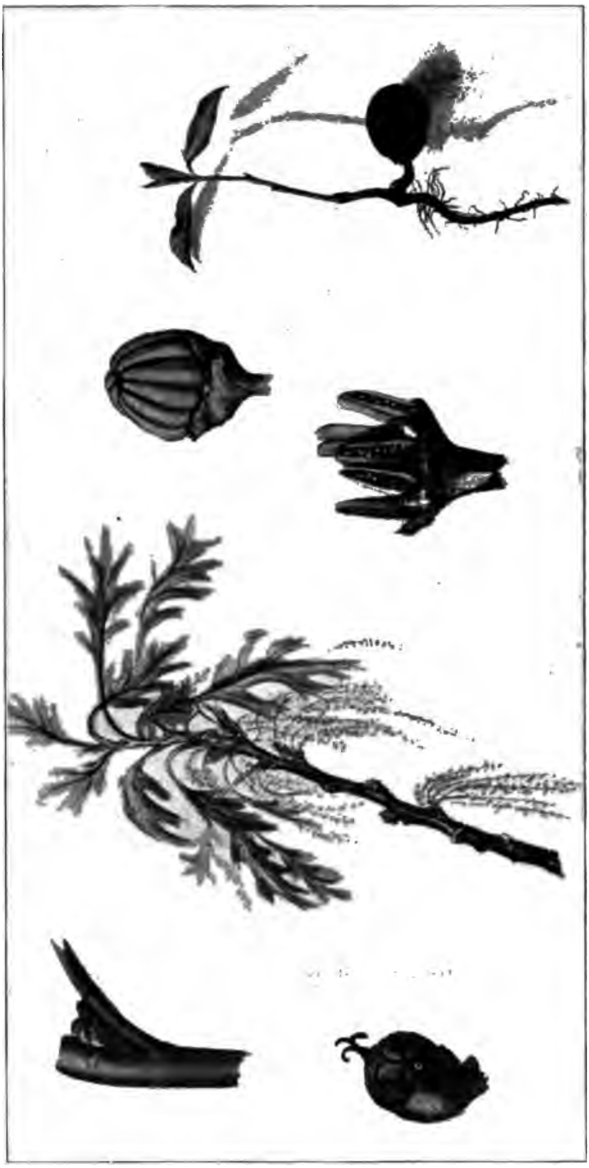

FIG. 6. The stages of the black oak. On the right, an acorn with young shoot; on the left, young acorns in the axil of a leaf above, fullgrown acorn below; branch with aments; on the right of the branch the unripened stamens above, mature stamens with pollen below. From water color drawings by Mrs. Edith Ricker.

before it has ripened and after it has dehisced or opened, setting the pollen free. The meally yellow dust that is shed so freely at the slightest touch is the pollen. Shaking the branch sets free a perfect cloud of it. It is borne off in the air like a whiff of smoke. Only one pollen grain is necessary to fertilize one ovule. Many pollen grains will of necessity, whatever be the mode of fertilization, fail to reach their intended place upon a ripe stigma. The ratio of pollen grains to the ovules must always be large. The night blooming Cereus has 250,000 pollen grains to 30,000 ovules, or about 8:1. The garden wistaria has a ratio of about 7,000 to 1 ovule. The Indian corn, pines and other wind fertilized flowers must have a much greater ratio than this.

One can see at a glance (Fig. 6) that the pollen grains of the oak, because of their position, stand little chance of falling upon the stigma of the branch upon which they are borne. It would require an upward draft of air or an insect or other animal to carry them. It would be easier to account for the transfer of the grain of pollen in this case by supposing it to have dropped gently from the boughs above. It may as well have been carried by a light breeze from a neighboring tree.

There is neither odor, nectar, edible pollen, nor showy corolla, to guide or attract a busy insect, and since all insects seem bent on business they would spend little time loafing around the oak blossom. In fact it would be a one-sided bargain for an insect to carry pollen for the oaks since he would derive no benefit to himself. Wherever a relationship is discovered between a plant and an animal it may be taken as axiomatic that the association is mutually beneficial. Darwin once staked his theory of organic evolution upon the proposition that if any organ or modification of an organ could be found in the animal or plant world that was present wholly for the benefit of another species, that he then must admit that his whole conception might be based upon false conclusions. Fifty years have passed and no one has produced the evidence.

Assuming that a pollen grain has found its place upon a sticky stigma of a pistillate flower let us see what takes place. The grain of pollen absorbs moisture and swells until it begins to grow a tube, somewhat as a seed sends down its radical. It either enters a space left between the cells or by penetrating the cells grows until it reaches the generative cell of the ovary. An interesting series of experiments has been made showing the cause of growth down the style to the ovule to be chemotaxis, or growth toward chemically attractive substance. The essential part of the pollen liquid now penetrates the ovule to the nucleus of the generative cell. There immediately follows an interesting series of phenomena of especial interest to the embryologist. In brief, the one cell subdivides many times and grows ultimately into an acorn, which one year later will be recognized as such a one as now appears on last year's growth. The season's growth increases it to the normal size and in September or October it is ripe and ready to leave the tree, and soon finds its resting place upon the ground. (The white oak and some others mature their acorns in one season. Not all the pistils are fertilized. Some of the acorns fail to grow the second year.) The fallen acorns roll about or are kicked or carried about by animals. Squirrels bury them at some distance from the tree. A great number are eaten by animals. Many others have been stung by diptera and a little white grub has eaten the food stored up for the plant.

But here and there one in a great many has been pressed into the ground and has felt the warmth of spring. It has split its weather worn casing and protrudes its white radical. The subtle attraction of gravity causes it to turn downward and bury itself still deeper in the earth. From the split in the hypocolyl where it branches to the two cotyledons arises the caulicle or stem. This is the part we will call the tree. The figure (Fig. 6) shows an oak the second year of its growth as an independent plant, or the fourth year from its beginning as a cell.

We will not here treat further of the growth of the tree. To consider in its entirety the manner of growth to the tree again producing acorns would be a treatise on botany too long to be given here.

We have traced the growth through the stages through which, in a general way, all plants of the higher orders must go.

The Forest Trees.

Harry Nichols Whitford.

(The material contained in this and the other botanical lectures is the outcome of a series of talks given at the biological station of the University of Montana at Bigfork, Montana, during the summer of 1902. The description of the conifers is intended to be an aid to the identification of the trees for the use of those not acquainted with botanical terms. In nearly all cases the points of difference between the trees have been tried and found applicable in determining the species. In the preparation of the key and descriptions, the author has made free use of the manuals covering the region and of Sargent's "Sylva of North America.")

An attempt has been made to show why there are **prairie** and **forest formations.** In the **forest formation** itself there are places where there are no trees, and in certain situations some trees will grow where others will not. It will not be out of place to ask why these things are so. But before proceeding, it is desirable to become acquainted with the kinds of trees that are found in the state. This enquiry will be confined to that group of trees called conifers, for the others form an inconspicuous part of the forest. Not only must the trees be known, but also their habits, so that what they will do in certain situations can be predicted.

It is not always an easy thing to distinguish the different species of trees. The difficulty of recognizing young trees from one another is even greater than with older trees; for the older trees may have cones, and these are, of course, more apt to give a clue to the identification. However, even from older trees cones are often absent. The bark of trees is very characteristic, and lumbermen use this mark to distinguish trees. But hereby mistakes are often made, for the bark is different at various ages; and a tree growing in one situation is likely to have different bark from the same species growing in another situation.

The leaves perhaps are less variable in their form than the bark, and as they are more often present than the cones, they will serve as a criterion in discriminating the species. With the exception of the western larch, the leaves of the conifers to be described are on the trees the year around, so the character drawn from them can be used in the winter as well as the summer. Since the leaves even on the same tree vary in shape, often more than one character will have to be used.

A Key to the Conifers of Montana.

A. Trees with leaves in clusters, excepting those first appearing on young shoots.
  I. Leaves in clusters of more than five........1. Larix (larch).
  II. Leaves in clusters of two to five..........2. Pinus (pines).
B. Trees with leaves not in clusters.

I. Leaves scale like.
  a. Leaves four ranked, the side ones ridged, the branchlets thus appear flattened ....3. Thuya (arbor-vitae).
  b. Leaves four ranked and all ridged, the branchlets thus appear four sided ....4. Juniperus (juniper).
II. Leaves needle like.
  a. Leaves jointed from a base that remains after the leaf is shed.
    Leaves flat, petiolate ....5. Tsuga (hemlock).
    Leaves sessile, and ridged on both sides............ ....6. Picea (spruce).
  b. Leaves not jointed from a base that remains after the leaf is shed.
    Leaves short petiolate leaving a triangular scar when shed ....7. Pseudotsuga.
    Leaves sessile leaving a round scar when shed...... ....8. Abies (Fir).

The genus **Larix** is easily distinguished from the other genera by the fact that it is the only deciduous conifer in Montana. There are two species in Montana.

Western Larch (1) (**Larix occidentalis** Nutt.):

This tree is known in the Flathead valley as the tamarack or larch. The new shoots have the leaves scattered. In the axils of these leaves appear buds which develop into short branches with a cluster of leaves at the end. Each year this short branch grows slightly in length, and a new ring of wood is added. The growth in length is so little, however, that the branchlets never become long. The leaves are soft compared with the other conifers, and have a lighter green color by which they may be distinguished in the forest. In the fall they turn yellow green and drop about the middle of October. The leaves are about one and a half inches long. Compared with those of other conifers the cones are small, but are about twice as large as the eastern tamarack (**Larix laricina** (Du Roi.), Koch.) They are from one to one and a half inches in length. The bract is longer than the scale. (2)

The bark (Fig. 7) of the older trees is smooth at first, then becomes deeply ridged, and when the tree is 75 to 100 years old, it is at the base four to five inches thick. It breaks up into oblong plates and is covered with scales which break off in scroll shaped patterns. These scales are

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(1) In this article the common and scientific names suggested by Sudworth of the United States Bureau of Forestry will be used. Nearly all of the western conifers have closely related species in the eastern part of the United States, and many have the same common names as their eastern relatives. It is desirable, therefore, to distinguish them by choosing a name that is not already in use. However, with these there will be given other common names that are in local use. See Sudworth, G. B., Check list of the forest trees of the United States, their names and ranges. Bull. No. 17, U. S. Dept. of Ag., Div. of Forestry.

(2) It may be well to state that the fruit of the conifers, known as the cone, is made up of closely imbricated scales. To the upper surface of each scale, two seeds are attached; on the lower surface, "bracts" are found. Usually the bracts are shorter than the scales.

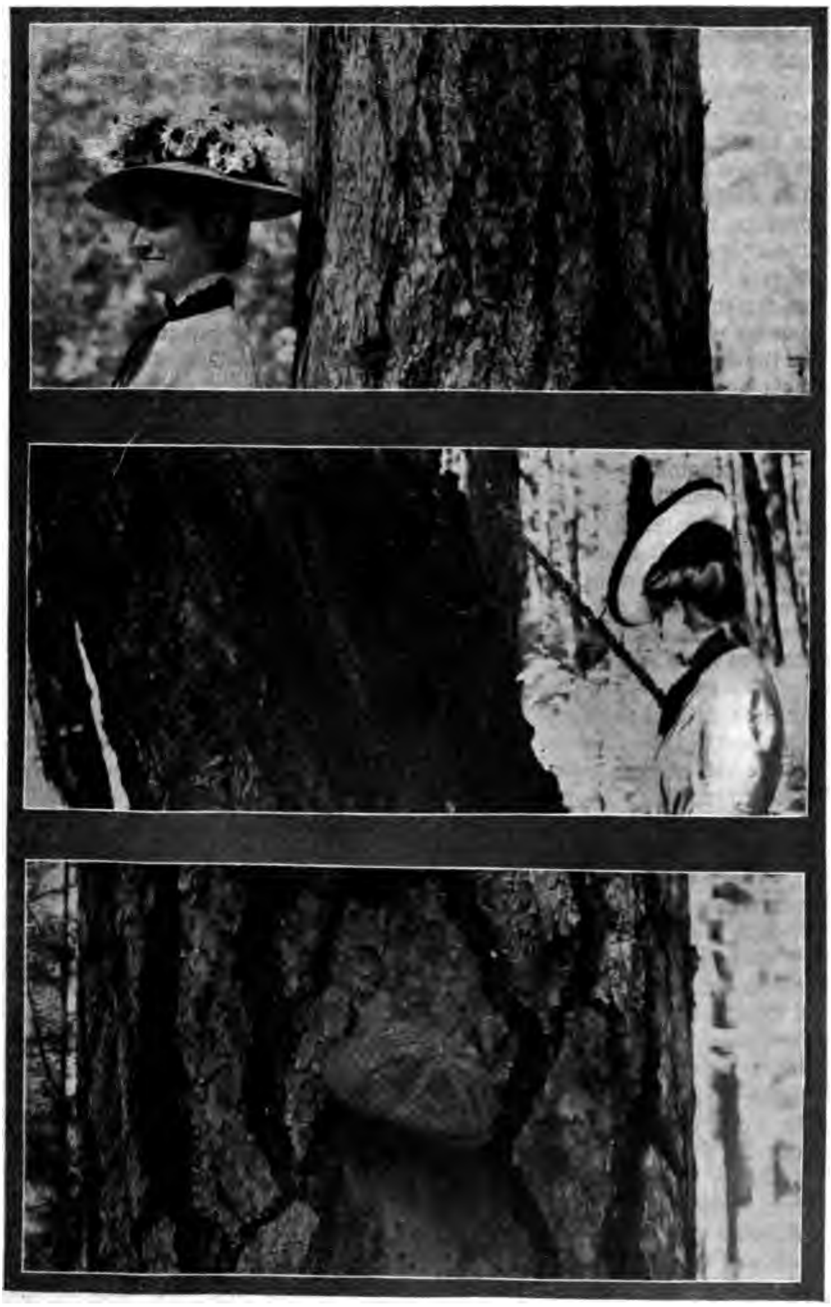

FIG. 7. Comparison of bark. Upper, tamarack. *Larix occidentalis* Nutt; middle, Douglas-spruce, *Pseudotsuga taxifolia* [Lam.] Brit; lower, Yellow pine, *Pinus ponderosa* Laws.

cinnamon red in color. The thick bark enables the tree to resist fires. This is, of course, of great advantage to the tree, for since fires have become more numerous, those trees that are easily destroyed by them are first excluded from the forest. The western larch is one of the last to suffer permanent injury from fires. Those seed-bearing trees that remain after fires will re-stock the burn with a new generation of trees. The western larch requires light in its seedling stages; hence it can reproduce itself only in open places. These may be caused by fire, by death of old trees, or by any accident that will remove the trees of the mature forest. The western larch is then exceedingly intolerant of shade.

In the Flathead valley the western larch does best in soil not too moist nor too dry. This tree is said to reach its greatest development in the basin of the upper Columbia river. In the United States it is most at home in the Flathead valley, and in northern Idaho. Here it may reach the height of 200 feet, with a trunk of five to six feet in diameter, and occasionally is even larger.

Mountain larch (Larix Lyallii Par.). The mountain larch is reported to be present in a few places at high altitudes in the mountains of northwestern Montana. It does not, however, form a conspicuous element in the forest. It is distinguished from the western larch by the fact that the leaves are nearly as thick as broad. In the latter species the leaves are somewhat wider than thick. The branchlets of the mountain larch are hairy, as compared with those of its lowland relative. The height of the tree is seldom over fifty feet.

The genus **Pinus (pine)** is easily distinguished from the other conifers by the fact that the needle like leaves are in groups of two, three, or five. The first leaves that are produced on the leading shoots are scale-like. In the axil of each scale-like leaf a bud may appear which develops soon into a branch, so short and inconspicuous as to be hardly recognizable. On each of these short branches, two, three, or five leaves appear, the number being usually definite in each species.

There are five species of pine in Montana. They may be divided into two groups, viz., those that have two or three leaves in a cluster or fascicle and those that have five leaves in a cluster. The latter, known as white pines, are represented by three species in Montana, and are seldom found growing together. In the Flathead valley the **silver pine** is found only in the lower altitudes. Near the timber line is the **white-bark pine.** (Plate XLVII.) This is usually on the west side of the continental divide. On the east side of the divide at high altitudes, the **limber pine** occurs. Aside from their mode of distribution, these three pines may usually be distinguished from one another by the length of their cones. The cones (Fig. 8) of the silver pine are from five to eleven inches in length, usually not less than eight; those of the limber pine from three to ten inches, most frequently under eight; and those of the white-bark pine from one and a half to three inches. The tips of the cones of the last named species are curved inward. The length of the leaves is variable, but usually in the silver pine they are long, in the white-bark pine and the timber pine they are short; the first of the last two named having the shorter leaves.

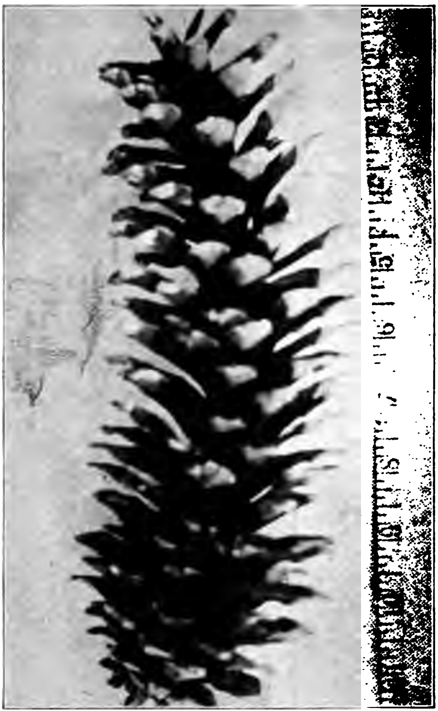

FIG. 8. Cone of Silver or White pine.

Silver pine (Pinus monticola, Dougl.): This pine is more frequently known as the white pine, or western white pine. It resembles very much the **white pine** of the eastern part of the United States. The cones of the former are much longer than those of the latter, and the leaves are more thick and rigid, and usually not so long. No tree in Montana has longer cones (Fig. 8) than the silver pine. The leaves of the silver pine are said to remain on the tree from three to four years. The trunk of the young trees has a smooth, thin, light gray bark. In the older trunks it becomes as much as an inch to an inch and a half thick, and is divided into nearly square plates which are very characteristic. When fired, the bark, is easily heated through, the cambium zone (3) is killed, and the tree thus destroyed. In contrast with the western larch the tree is slightly tolerant of shade, that is, it can exist as a seedling in the shade of other trees. In the Flathead valley it is confined to soils that are quite moist. It cannot be said to be a very successful tree here, although in favorable situations it reaches good size. Isolated trees may be found at rather high altitudes, although it was not seen to overlap in its distribution the white-bark pine of the higher altitudes. It is said to reach its best development in the bottom-lands of streams tributary to Lake Pend' d'Oreille.

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(3) The cambium zone is the active growing region between wood and bark that enables the tree to increase in diameter; in the bark and therefore outside the cambium zone is the region that conducts certain food materials from the leaves to the roots. If these regions be killed, the tree will shortly perish.

The **white-bark pine (Pinus albicaulis** Engelm.): It is distinctly an alpine form. (Fig. 9.) The leaves are in clusters of five, and from one and a half to two and a half inches in length. They are said to persist for from five to eight years, most of them remaining on the trees from seven to eight years. The bark is very thin. It is quite smooth and is creamy white in appearance, hence the name **white-bark pine. It is** easily destroyed by fire. The white-bark pine grows on the most exposed ridges in high altitudes. It is confined to the western continental divide, where it is usually associated with the alpine fir.

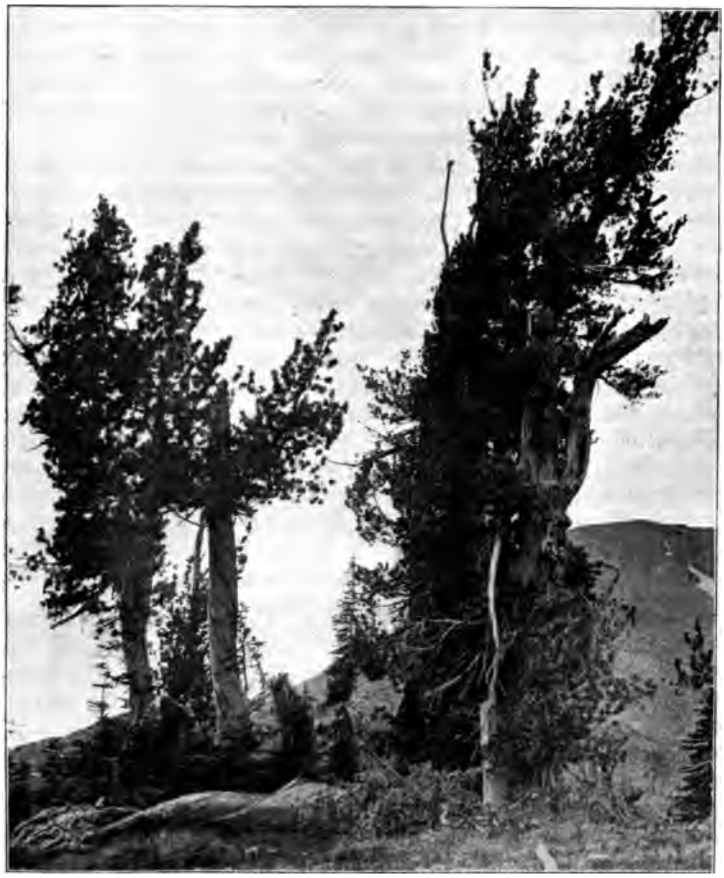


FIG. 9. White-bark pine on the slope of Sinyaleamin Mountain, at altitude of 7800 feet, showing the struggle they make for an existence. Photo by Prof. L. A. Youtz.

The limber pine (Pinus flexilis James): The tree may usually be distinguished from the former species by its rougher bark and longer cones. It is found on the eastern side of the continental divide, usually at altitudes of from 5,000 to 10,000 feet.

The two remaining pines found in Montana are the **bull pine** and the **lodgepole pine.** They can be easily distinguished by the length of the leaves and the number in a cluster. The former has usually three, sometimes two, long leaves; the latter, two shorter leaves.

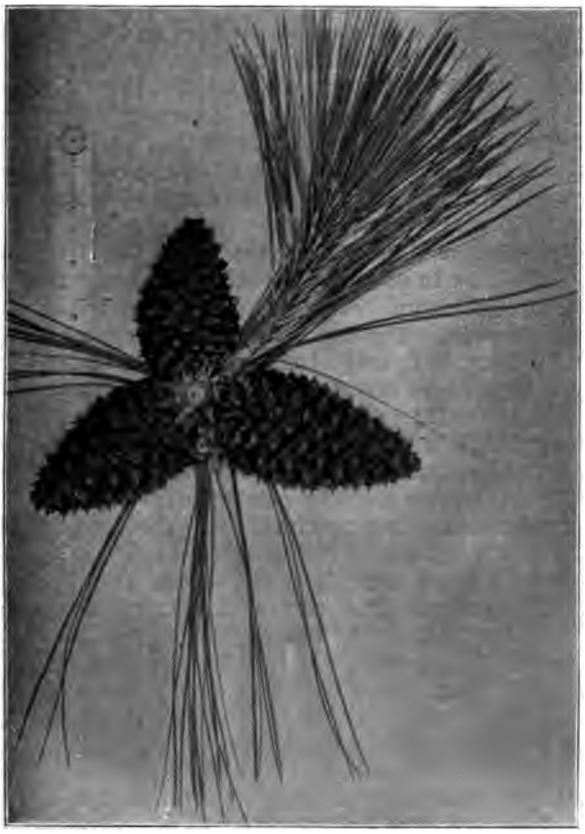


FIG 10. Leaves and cones of the bull or yellow pine. Photo by M. J. E.

The bull pine (Pinus ponderosa Laws.): The bull pine, (Fig. 10) more often called yellow pine, is one of the most striking, widely distributed, and most valuable trees of Montana. The comparatively long leaves are usually in clusters of three, though occasionally two are found. They persist usually for three years. They form great clusters at the ends of the naked branches. The cones (Fig. 10) of the bull pine are three to six inches long, and often in clusters of three to five. The tips of the bracts are elongated into awnlike characteristic spines. The bark is very striking. (Fig. 7.) In the older trees it is split up into long rhomboidal plates, covered with scroll-like yellow scales, very much resembling those of the western larch. At this stage the tree is known by certain lumbermen as the **yellow pine.** In the younger trees the bark is more ridged and rounded, and does not have the yellow color. This form goes under the name of **bull pine.** In the older trees the bark is two to four inches thick and very resistant to fires.

In the Flathead valley the tree is confined to the low altitudes, and is more abundant on the border of the prairie, though it does better in moister situations. It is, perhaps, shaded out of these places because of its extreme intolerance of shade. It needs very open places in which to germinate, and very little shade will prevent this. The bull pine and its closely related form, the **rock pine (Pinus ponderosa scopulorum** Engelm.), are found throughout the western part of America. The latter has not been reported from Montana.

The **lodgepole pine (Pinus Murrayana** "Oreg. Com."): The leaves of the lodgepole pine are in pairs one to two inches long, and remain on the trees seven to eight years. The cones are smaller than those of any other pine in Montana. The tree resembles the **jack pine (Pinus divaricata** (Ait.) Du Mont de Cours.) of the eastern part of the United States in its general appearance and some of its habits. The bark of smaller trees is smooth. On the older trees it breaks up into rectangular plates, and is about one inch in thickness. It is a tree easily destroyed by fire, but because it can produce cones at a very early age, it has a very great advantage over the other trees in gaining a foothold in burned areas. Groves of small trees six to ten years old may produce cones abundantly. Another remarkable feature of the lodgepole pine, is that the scales of the cones remain closed, sometimes for several years, thus preserving the vitality of the seeds for a comparatively long period. The seeds from cones nine years old have germinated. The heat of the fires sweeping through a forest will open cones, liberating, though not often destroying the seeds, which germinate at once, and thus give a decided lodgepole pine aspect to the new growth. In closed forests the lodgepole pine has small diameter and great length. Trees over a hundred feet tall often are no more than six inches in diameter. Where there is plenty of room for the lodgepole pine to grow the dameter is greater, and the height less. The lodgepole pine has a rather wide distribution in western Montana. It is usually confined to rather moist situations. So successful has it been in gaining a foothold after fires, that it has replaced many square miles of valuable timber. It cannot tolerate shade, however, and if fires are kept out, in several generations the forest conditions will probably be the same as before the original forest was destroyed.

The **giant arbor-vitae** and the **Rocky mountain juniper** are easily distinguished from the remaining conifers by their scalelike leaves. In the giant arborvitae they closely overlap. In the Rocky mountain juniper they do not overlap so closely.

The **giant arbor-vitae (Thuya plicata** Don.) **(Thuya gigantea** Nuttall): This tree resembles its eastern relative the arbor-vitae **(Thuya occidentalis** Linn.) very closely, both in appearance and in habits. (Fig.

[illegible] Arbor vitæ forest.

11.) The cones are considerably larger than in the latter, and there are six scales that bear seeds, instead of four. Other common names for the giant arbor-vitae are red cedar and cedar. The leaves on the side branches are opposite, scalelike, about one-eighth of an inch long. They overlap very closely, and fall usually in the third year. The cones are one-half an inch long and ripen the first season. The bark (Fig. 11) is one-half to three inches thick, and is irregularly divided into broad ridges which have long shredded scales. The tree is said to resist fires fairly well, and can tolerate shade. It is not frequent in Montana, and is confined to moist situations on the western slopes of the Rocky mountains in the northwestern part of the state. It reaches its greatest development on the Pacific coast.

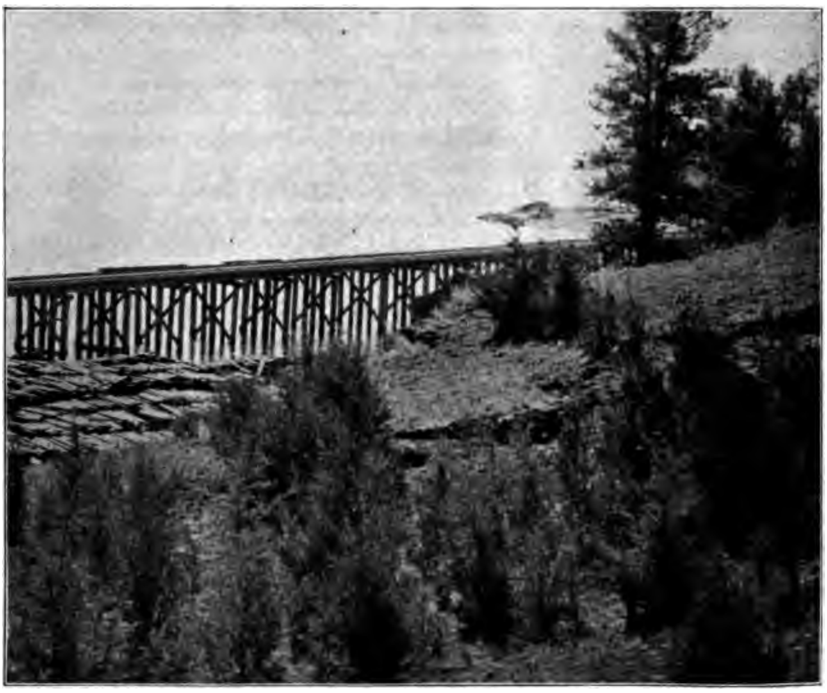


FIG. 12. Growth of young Rocky Mountain Junipers on the bank of Flathead lake, near the O'Brien mill. Photo by M. J. E.

The **Rocky mountain juniper, (Junipers scopulorum Sarg.)**: The Rocky mountain juniper is called frequently cedar or red cedar. It resembles its eastern relative (**Juniperus Virginiana** Linn.) though the fruit is larger and matures in two years instead of one. The leaves are opposite and do not overlap so closely as in the giant arbor-vitae. The bark is about one-half an inch thick and has thin shreddy scales. The cones, commonly known as "juniper berries," bear two or three seeds. This tree is common on the borders of Flathead lake, (Fig. 12.) and is found in various parts of the state.

The western hemlock (Tsuga heterophylla (Raf.) Sarg.): This tree, commonly known as the hemlock, differs from its eastern relative (**Tsuga canadensis** (Linn.) Carr.) in having slightly larger cones with scales longer than broad. In the eastern species the scales are nearly as broad as long, and the cones have a stalk, whereas the cones of the western species are sessile. The leaves are rounded at the apex, flat, dark green above, white below, and have short leaf stalks, or petioles. The bark on full-grown trees is about one and a quarter inches thick and has rather broad flat connected ridges with brownish scales. The tree, like the giant arborvitae, is very tolerant of shade. It is even more restricted in Montana than the giant arborvitae, and like it reaches its best development on the Pacific coast. (Fig. 13.)

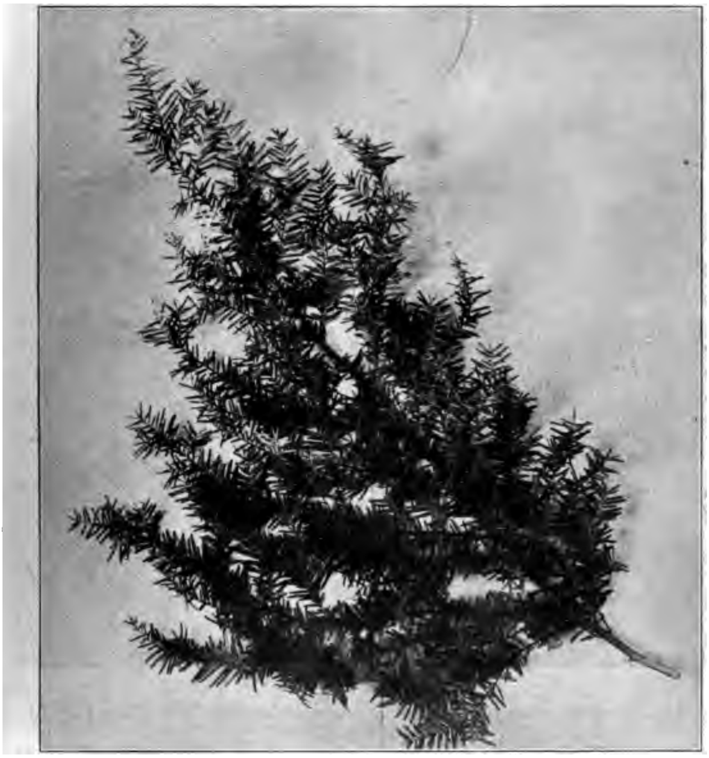


Fig. 13. Leaves and cones of the western Hemlock. Photo by M. J. E.

The young trees of the **Douglas spruce, lowland fir, Engelmann spruce** and **Alpine fir** look alike to the uninitiated. The last named species is not often associated with the others, and hence is not so likely to be mistaken for it. The base of the leaf of the Engelmann spruce is woody, and remains attached to the stem after the leaf is shed, thus leaving peglike projections on the stem. The spruce can be easily distinguished thereby from the other three trees. The western hemlock, howev has these peglike projections also, though they are not nearly so pro nent. The leaf of the spruce is roundish in cross section, while that the hemlock is more flattened. The leaves of the side branches of t lowland fir are dark green above and usually conspicuously notched the end, while those on the side branches of the Douglas spruce are li

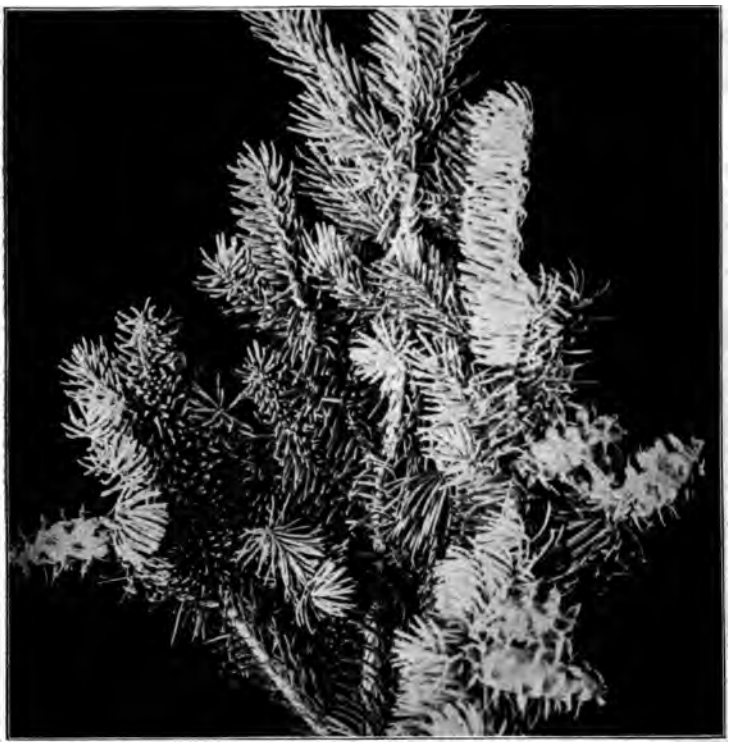


FIG. 14. Leaves and cones of Douglas spruce or lowland fir. Photo by M. J

yellow when young, usually dark green when older, and not notched at t end. The scar left by the former when the leaf is shed is round, wh that left by the latter is more triangular in shape. The leaf of t former is sessile, and that of the latter has a very short leaf stalk. T cones of the Douglas spruce (Fig. 14) and Engelmann spruce hang do while those of the firs are erect. The cones of the Douglas spruce ha the bracts longer than the scales which easily distinguishes it from Engelmann spruce.

The **Engelmann spruce (Picea Engelmanni** Engelm.): This t closely resemble the **white spruce** of the east (**Picea canadensis** (Mi B. S. P.) Indeed the white spruce is said by some authors to be fou in Montana, though others doubt its existence here. If it is found, it difficult to distinguish it from the Engelmann spruce. The leaves the lower branches are usually short, stout, roundish in cross section. sharp pointed and a dark blue-green in color. They persist about eight years. The cones (Fig. 15) are about two inches long, sessile or very short stalked. At first they are horizontal but later drop. They mature at the end of the first season. The bark is thin and broken into large flaky scales. The tree on account of its thin bark, is easily destroyed by fire. It tolerates shade fairly well. It reaches its best development in moist situations, in swamps, along streams, and on moist hillsides. Outside of Montana it has a wide range in the western part of the United States and British America, usually in rather high altitudes.

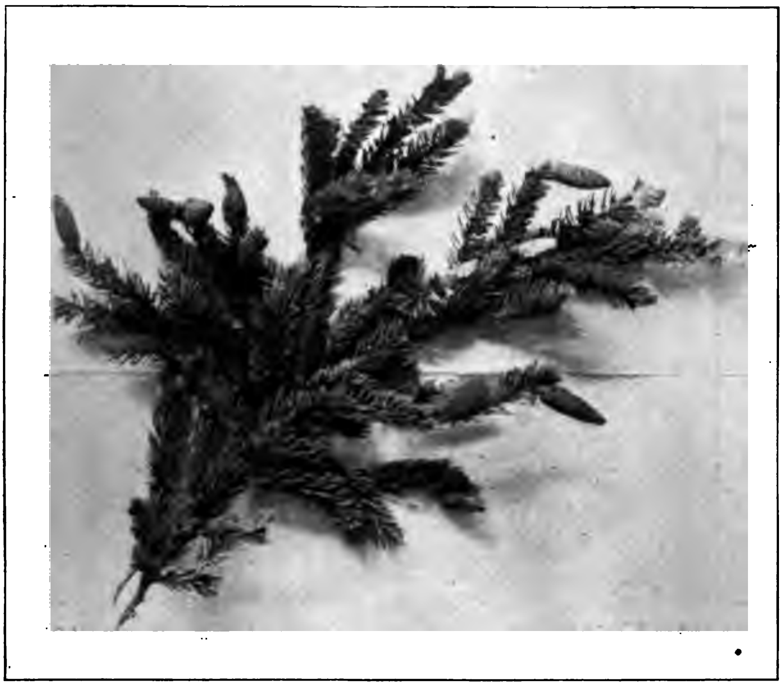


FIG. 15. Leaves and cones of Engelmann's spruce. Photo by M. J. E.

The **Douglas spruce (Pseudotsuga taxifolia** (Lam.) Brit.) **(Pseudotsuga Douglassii** Car.): This tree, also known as the red fir, is neither spruce nor a fir, the name **Picea** being reserved for the former, and **Abies** for the latter. The word **Pseudotsuga** means literally "false hemlock," but the name has little or no significance.

The leaves of this tree have already been described. They remain on the tree about eight years . The cones, (Fig. 14) as already stated, are easily characterized by the fact that the bracts are longer than the scales. They vary in size from two to four inches. The bark (Fig. 7) of the tree varies greatly as the tree ages. In the older trees it is composed of large, broad, irregularly connected ridges. The bark is very thick at the base, usually from six to twelve inches, and even in exceptional cases two feet. By its thick bark (Fig. 7) the tree is well protected from fires. It does not tolerate shade. In this respect it may be classed with the western larch and lodgepole pine. In the Flathead valley the tree is associated with the western larch in moister soils and with the bull pine in drier soils. It does not, however, reach the dimensions here that it does on the Pacific coast, where, with the western hemlock and arbor-vitae, it forms luxuriant forests. The Douglas spruce is distributed throughout the western part of the United States, but in dry climates it is small and stunted in growth.

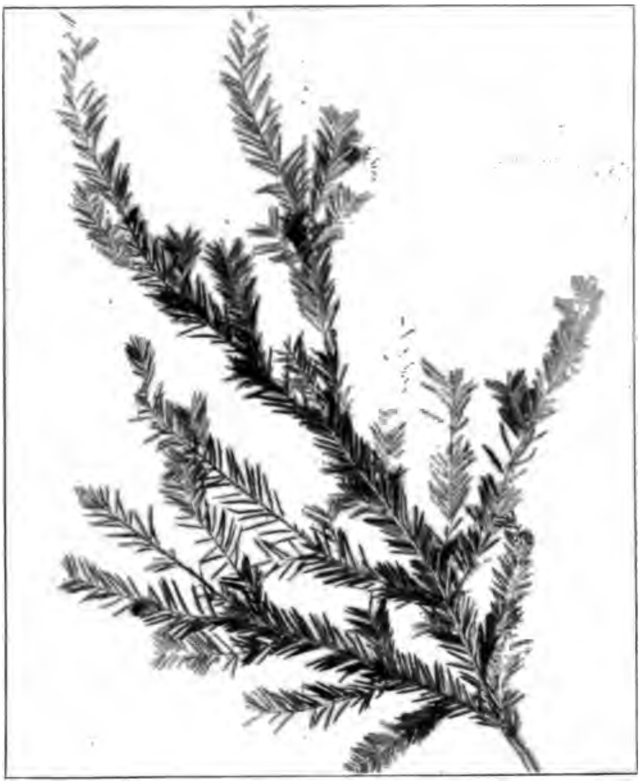


FIG. 16 The Yew, showing leaves and berries. Photo by M. J. E.

The **lowland fir (Abies grandis** Lind.): This tree is also known as the white fir and the balsam fir. The leaves have already been described. On the horizontal branches they are conspicuously two ranked. They persist from eight to ten years. The cones are erect on branches near the top of the tree, and vary in length from two to four inches. The scales of the cones, as in all firs, are deciduous, the cone axis being shed later. The fruit matures in one season. The bark is smooth at first, with the characteristic balsam blisters. Later the bark splits into low flat ridges, giving it the name of "rough bark fir" in some sections of the country. It is sometimes two inches thick, though usually thinner. The tree tolerates shade fairly well. It is not at home in the Flathead valley, though in favorable places it reaches comparatively large dimensions. Like so many of the other conifers it does its best on the Pacific coast. It is confined to low altitudes, seldom reaching above 3,500 feet.

The **alpine fir (Abies lasiocarpa** (Hook) Nutt.): This tree is also known as the balsam fir. The leaves of the lower branches resemble those of the lowland fir, though in trees growing side by side those of the alpine fir are narrower and lighter green than the leaves of the lowland fir. The cones are much alike also. The seeds have bright violet wings and can thus be easily distinguished from the pale colorless wings of the seeds of the lowland fir. The bark of the lowland fir is grayish or reddish brown, while that of the alpine fir is much lighter. The bark of the former is also much more ridged than that of the latter, which remains more or less smooth until very old age. The alpine fir, as its name implies, is a tree of the alpine regions. It does its best, however, in damp canyons, where it is associated with the Engelmann spruce. In the higher altitudes it is a companion of the white-bark pine on the exposed ridges, but is more at home in basins, occupying the places where the snow disappears first. It is found throughout the alpine regions in the western part of the United States, and reaches as far south as northern Arizona. (See frontispiece for characteristic locality for growth. On the extreme right is the tapering top of a beautiful tree.)

Daphnia Pond.

A STUDY IN ENVIRONMENT.

Morton John Elrod.

Daphnia Pond lies along the road about a mile and a half south of the laboratory. It is a small land locked pond, covering some 10 or 12 acres. It is undoubtedly of glacial origin, lying in a small pocket between two ridges of rock made by faulting. Its outlet in spring is to Flathead lake, a hundred feet lower in altitude. The pond lies in a glaciated region and is no doubt the result of glacial action. Within a few miles of Daphnia a dozen other ponds of similar nature may be found with similar origin, and offering the same field for study.

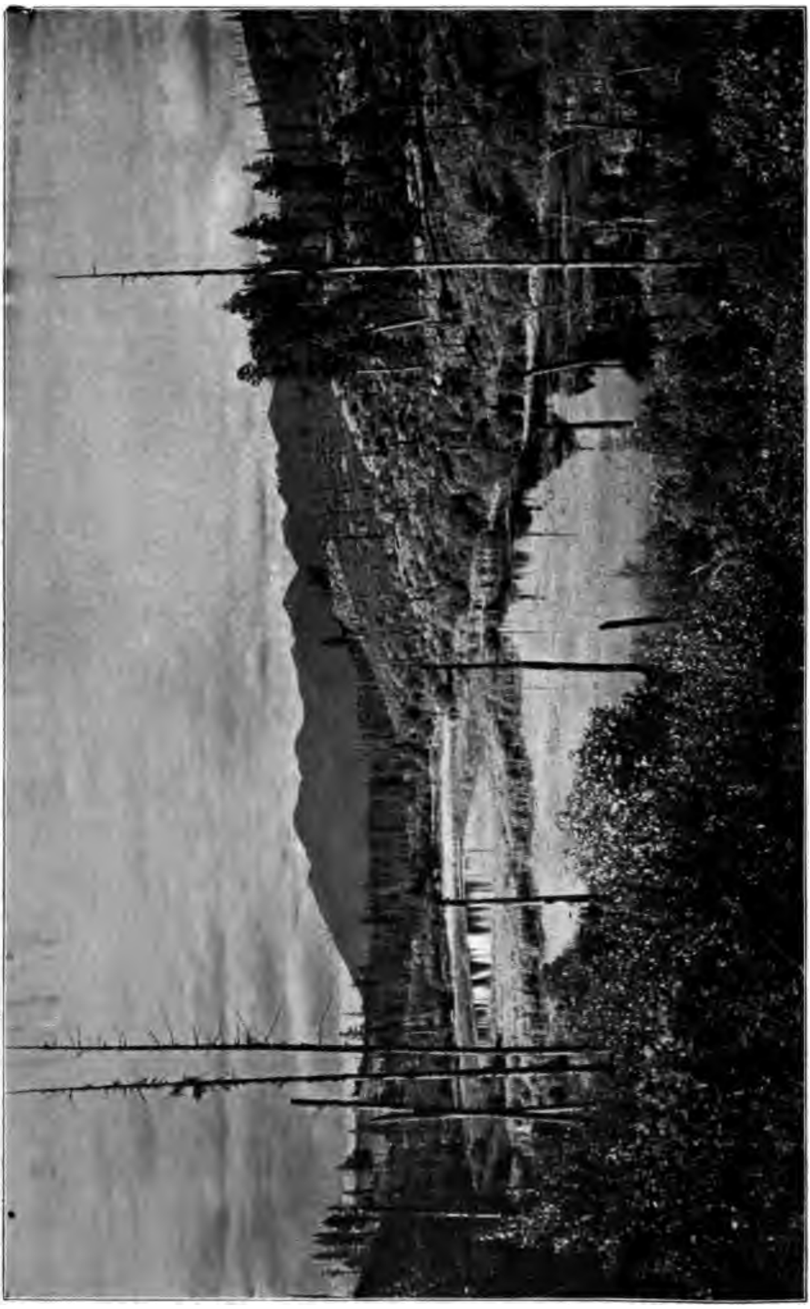
The pond is shallow at either end and 20 feet deep in the middle. The shallow places are overgrown with rushes, moss, water lilies, and other aquatic forms of vegetable life. A small place in the center has open free water. Around the banks there is the usual growth of willows, while numerous logs and dead bushes make the water difficult to reach. The bottom is largely of boulders, filled in between with mud, and overgrown with rank and dense vegetation.

The name Daphnia was given because of the great numbers of the entomostracan **Daphnia pulex** found in the pond.

Environment is a biological term having reference to the physical conditions affecting an organism. As referred to human beings we say the environment is good when the conditions are so favorable as to lead to good results. When a boy is sent to college he is in a good environment if his professors, his associates, his boarding house, and his companions all encouarge him to such effort as will bring about the best results mentally, morally, and physically.

The environment may, of course, be bad. In that case the results are not what are desired. Bad companions and associates, bad tendencies, may bring about conditions of mind and body disastrous to the individual possessing them.

According to the best information we now possess, when an organism comes into existence it has certain hereditary tendencies. These are only tendencies, and are immediately intensified or diminished by the conditions in which it is placed. In addition to these hereditary tendencies each living organism has within itself, be they few or many, some characters which are called acquired characters, which originate within the organism, and are affected the same as hereditary characters. Often these are powerfully influenced by environment, are intensified to a marked degree, and apparently modify the entire life of the species and its descendants. Hereditary or acquired characters or tendencies, affected by environment, make the species what they are.



Daphnia pond, near the station. Note the hydrophytic vegetation with open water in the middle. Swan range in the distance. The view is north. Photo by M. J. E.

Environment may mean any of the following conditions: Physical conditions, temperature and moisture, so as to make food abundant and the conditions favorable to life. In such a case the species would multiply rapidly, with little tendency to variation from the normal condition. These conditions may be such as to make food scarce, make life a struggle, and kill off the great majority of the organisms of a species. In such a case there is marked tendency to variation. Those characters or traits most useful or helpful in the struggle will be selected, and organisms differing from their ancestors in some ways will be the result.

Again: in addition to the above two cases, and modifying either, there may be the presence or absence of natural enemies, which prey upon the organisms, increasing or reducing in numbers accordingly. Where food is most abundant and enemies practically absent there is great multiplication of numbers. Illustrations of these conditions are to be seen in America in the English sparrow, the San Jose scale, the codling and gypsy moths, and other noxious insects. Where food is scarce and enemies abundant there is either great variation or extinction of species, or both. Under such circumstances the struggle is keenest and most severe, those least able to survive are killed, and the resulting and living specimens are likely to be strong and hardy, unlike their ancestors, continuing to vary in structure so long as the hard conditions exist.

Let us make application of these principles to the life as we find it in Daphnia Pond.

Vegetable Life. Trees are absent. As no trees in the region other than willow shrubs can live in water the pond must be older than any trees growing near it.

When water collects in any place it is immediately invaded by certain forms of vegetable life, water plants. In sustaining life these plants begin to fill the pond. Their roots sink into the soil to hold the plant. Their stems become so thick and matted that whatever silt is brought into the water is held, and is not permitted to run out. The pond is gradually filled in, the plants in living, slowly make living impossible, and the result is the extinction of the pond and the death of both its animal and vegetable life.

Daphnia pond admirably illustrates the method by which a pond is filled. In the center is a small space of open water, twenty feet deep. This is bordered by a fringe of yellow water lilies, whose roots are deep in the mud, and whose leaves reach up through five or six feet of water to the surface. Among these are matted masses of lower forms of vegetable life. Outside, in shallower water, the rushes and cattails hold sway, their decaying leaves and stems each year adding to the decayed vegetable material. Nearer the shore the sedges have taken hold, and formed large hummocks, sufficient to bear the weight of a man. Along shore willows have taken firm hold on the soil.

This tangled mass of hydrophytic vegetation affords abundant hiding place for various forms of animal life, and at the same time supplies food for them, as testified by their great numbers.

The glaciated ridges adjacent have in very recent years been cleared by fires. A new vegetable growth is appearing, which may change the life materially.

Animal Life. Vertebrates are scarce in the waters of Daphnia pond. Fish are absent. This goes to prove that the pond has at no time had sufficient outflow to permit the ascent of fish from Flathead lake. Certainly fish could live in the water, since it is clear and cold, and probably has underground seepage. There is a good supply of animal food. Frogs are rather abundant, as are also garter snakes. The frogs prey upon insects, the snakes upon both insects and frogs. A dark green grass snake has also been observed. A single species of turtle has been seen, but they are rare. Among the rushes a few muskrat homes have been built, but the animals are scarce and shy.

The invertebrate life is abundant in numbers of specimens, but not in species. Three species of shells are found in the water, one on land. **Planorbis trivolvis** Say and **Sphaerium partumeium** Say are abundant in the hydrophytic vegetation. **Physa ampullacea** Gld. is rather common. **Pyramidula strigosa**, var. **cooperi** W. G. B. is found in damp places on land. It seems strange that but a single land snail has been found.

Among the entomostraca **Daphnia pulex** holds sway. So abundant is the species that the water in the open space near the center is colored a dull reddish brown. They may be taken in any quantity. Forbes reports that this species is probably a fish food. This may explain its scarcity in Flathead lake as compared with Daphnia pond. Forbes reported the species as absent from Flathead lake. It has been found by us in our studies each year up to present writing. Much less abundant, but still common, is **Diaptomus lintoni** Forbes, while in still smaller numbers is found **Cyclops pulchellus** Koch. **Gammarus,** probably two species, hide among the water lilies and rushes.

Insects are abundant. It is no doubt a breeding place for mosquitoes, although no larvae have been taken. Unidentified dipterous larvae in considerable numbers have been taken. No fewer than ten species of dragonflies have been captured on the wing. Most of these have also been secured in larval stage. Other material to be found in the pond in abundance may be mentioned; many beetles, two leeches, several case worms, many water bugs, diptera, and worms.

The vicinity of this pond is a great breeding place for birds. No fewer than forty-five to fifty migrants build their nests and rear their young within a hundred yards of the water's edge. For so small a pond this is a very good showing. On all sides the timber has been destroyed by fire. Thus most of the shelter formerly afforded has been removed. The nesting sites are confined to the low bushes along the water's edge, to those which have sprung up in the burnt area, to the dead boles left by the fire, and to the grass and reeds of the pond. Rails are heard daily as they move around among the weeds. Golden-eyes and grebes usually rear their young in the grass. Catbirds, western yellowthroats, flycatchers, chickadees, sparrows, juncos and woodpeckers, all are found. The tree dwelling warblers find a few trees near by. Kingbirds may always be noticed, noisily chattering as they leave their perches in pursuit of insects. The total number of species of birds observed in the vicinity of Flathead lake as given by Silloway is 135. One-third of these may be found in the immediate neighborhood of this one small pond, showing the opportunity for study afforded by it.

Of the smaller microscopic life of the waters no examination has been made. Of protoza, diatoms, desmids, and the smaller worms there is no doubt a large number owing to the abundance of entomostracan life which the pond supports.

Owing to the size and character of the pond it offers an admirable site for detailed study of several forms of animal and vegetable life with respect to environment, with opportunities for experiments in changing the conditions, thus vitally affecting the lives of the inhabitants. In comparison with the waters of Flathead lake Daphnia pond teems with life, although but a short distance from the former, and insignificant in size in comparison. In the large lake there is little protection along the shore, owing to the pebbly nature, almost none in the bottom. The vegetation is confined to a few areas at either end where shallow water makes a swamp, and where vegetation can have a footing. The water is clear, cold and deep. Receiving a constant influx of cold water from the Swan and Flathead rivers, the lake does not cool rapidly save in the shallow bays where the water has little motion. In Daphnia pond, however, there is abundant vegetation. Great mats of it may be pulled out from almost any portion, from the growing green plants uppermost to the dead and decaying peat below. This mass is alive with living and crawling objects, which here find ample protection. There are no fish to destroy them while in the larval stage, hence they multiply rapidly. Among insects many have been mentioned. As these emerge from the water to the air they prey upon each other, and are in turn preyed upon by birds. A bittern was killed with his stomach full of the dragonfly **Aeschna constricta.** Kingbirds are known to prey upon them also. There can be little doubt but that many species of birds live principally upon the insects about the pond, although no examination of stomachs has been made other than as above mentioned.

Daphnia pond is commended to the students of the station laboratory as an excellent place for securing material for statistical studies in variation, for determining the relationships of hydrophytic and hydrozoic life, and for experiments on both forms of life. It offers to teachers an admirable place for securing material for class use, being one of the best collecting fields discovered in this section of the state.

Types of Nests of Birds.

TYPES OF NESTS OF BIRDS, WITH SPECIAL REFERENCE TO THE FLATHEAD REGION.

Perley Milton Silloway.

The nest-building habit of the birds is a marvel of inherited experience. Is it not remrakable that these feathered creatures of the air, roaming among the foliage of trees, bushes, or meadows for the greater part of the year, should settle upon a particular site, and construct a habitation that often withstands the climatic vicissitudes of many seasons? We regard the cowbird as peculiar because of its habit of stealing among the bushes and depositing its eggs in the nests of other birds; but are not the other birds even more peculiar in their instinct of suspending their Bohemian habits for a short period, and settling down to the humdrum occupation of house-building and home-keeping? When we remember that for eleven-twelfths of the year the birds have no place of shelter

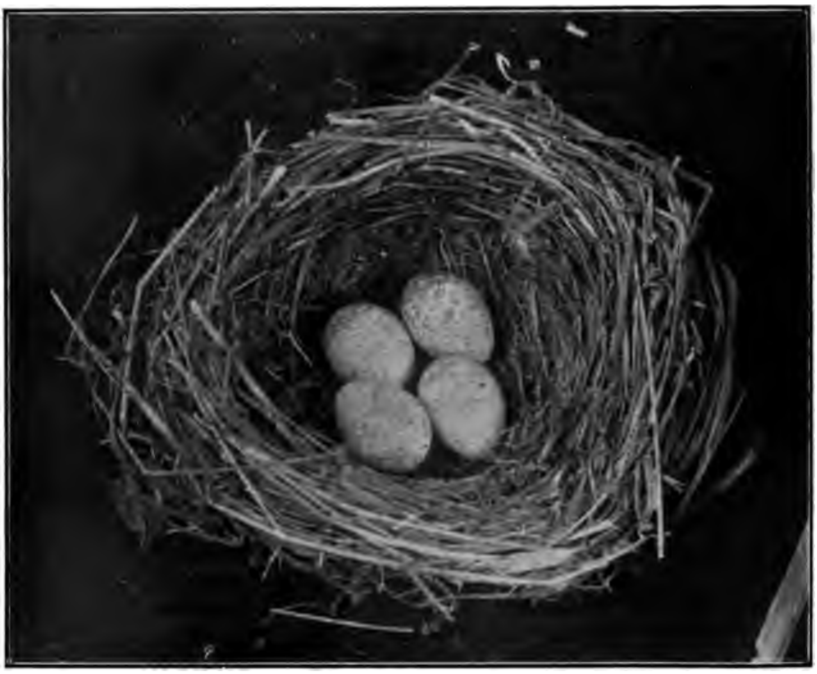


FIG. 17. Nest and Eggs of Olive-backed Thrush.

or retreat known as home, we may well wonder at the power of the impulse or instinct that leads them to build a strong dwelling for use but several weeks at most, and confine their activities to a limited range.

The knowledge of nest-building manifested by the birds is doubtless inherited. This theory is strengthened when we learn that birds of the same species construct nests of the same general type, following a common pattern of architecture and using materials of similar texture. A robin's nest in Montana differs in no essential feature of structure or material from one in Illinois or New York, and generation after generation of robins construct nests of the same typical style. If a robin be taken from the nest and reared apart from other robins, its attempts at nest-building will follow the plan approved by years of robin experience. Therefore when the bird-student becomes familiar with the type of nest constructed by any species of his avian friend, he will be able to identify the nest of that species thereafter with little difficulty.

After selecting a convenient crotch of some tree not far removed from civilization, the robin makes a substantial foundation of dried grass, strings, rags, or other similar material. Upon and within this Mrs. Robin erects a strong mud wall, smoothing it interiorly by rubbing and molding it with her breast. Then she places a bedding of coarse dried grass in the bottom of her cot, and she has a habitation as comfortable as a prairie settler's dug-out.

Among the nest-builders of the Flathead region, the olive-backed thrush is quite abundant. It selects a site near the top of a small fir tree, from six to ten feet from the ground, or in an upright crotch of a slender sapling, generally in the edge of a swamp or retired woods. The base of the nest (Fig. 17) is a loose mass of dried grass and weed-stems, upon which the builder forms a snug-walled structure of dark-green lichen and fine dried grass, the latter also serving as lining for the nest. It is said that in more northern localities a larger proportion of moss and lichen is used by this thrush, but the type of architecture is characteristic wherever the thrush is found nesting.

Belonging to the same genus as tne olive-backed is the willow thrush. It is the rule that birds of the same genus have similar habits of nidification, but the willow thrush differs very materially from its congener in its plan of architecture. It uses very coarse weed-stems and strips of bark, pine needles, and dried leaves, all dark material, making a thick-walled cup generally deeper than the work of the olive-backed, lining it with dark root-fibers. This nest is generally placed on or near the ground, frequently on a heap of decaying leaves or similar rubbish. In 1902, however, a nest of this thrush was found six feet from the ground, in an upright crotch of an oblique sapling, a very unusual situation for the nest of the willow thrush.

The catbird is one of the common birds of this portion of the Flathead region. Its nest is made in a low bush, usually among upright stems. It is a bulky structure, also made of dark material. Like the willow thrush, the catbird uses strips of coarse bark, weaving them into a strong basket, which it lines with coarse rootlets. Pieces of dried leaves, and fragments of twigs are also used in the framework of the catbird's nest. In appearance this nest closely resembles that of the willow thrush, though the different site in each case renders identification quite easy.

A type of nest radically different from any of the foregoing is presented by the American dipper, a bird which haunts the rapids of our mountain brooks, and plays in the splashing waters as they foam among the rocks or dash down the rock declevities. The nest of the dipper is a hollow ball of green moss, oftenest situated where it is kept soft and moist by the spray of rapids or falls, on a shelf of rock, or among the roots of trees washed by the brawling stream. On one side of this mossy, dome-shaped habitation is a circular entrance, and within it is an inner nest of leaves and grass. The site is nearly always among mossy surroundings, and the nest is easily overlooked by anyone not familiar with the nesting habits of the dipper.

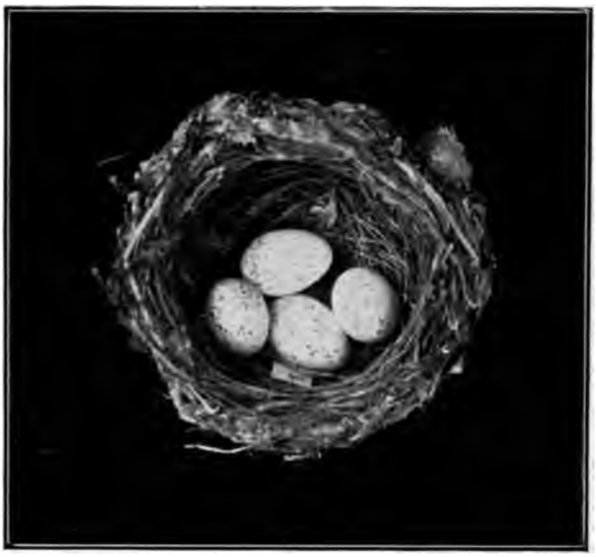


FIG. 18. Nest and Eggs of American Redstart *Setophaga ruticilla L.*

Among the warblers of this region, the American redstart is a nest-builder of some note. It chooses dark gray-colored material (Fig. 18), such as fine strips of inner bark-fibers of weed-stems, bits of dark green lichen, flakes of gossamer, and fibrous grasses. These it shapes into a neat, well-rounded cup, fitted into some crotch formed by a small twig and a larger branch, generally upright, from six to twenty feet from the ground. In size the nest is probably the smallest among the warblers, and is difficult to detect in the gloomy light of the swamp-woods, as it resembles an enlargement at a joint of the branch.

The ground-dwelling warblers of this region manifest a great similarity of taste in their style of architecture. In this group are the western yellow-throat and Macgillivray's warbler, both of which make their nests in grass tufts, about eight inches from the ground. The structure is made exteriorly of long pieces of grass stems, interiorly of fine dried grass, rootlets and horsehair. When made in a grass tuft among rank sprouts and small bushes, the nest of Macgillivray's warbler cannot be distinguished from that of the yellowthroat in similar situations. However, the yellowthroat chooses other sites, notably the rushes of ponds and swamps. In such situations the nest material is likely to be taken from that nearest at hand. A nest of the yellowthroat taken from Daphnia pond was made altogether of pieces of dried flag, with a lining of fine grass, thus resembling a cup-shaped basket of irregular weaving.

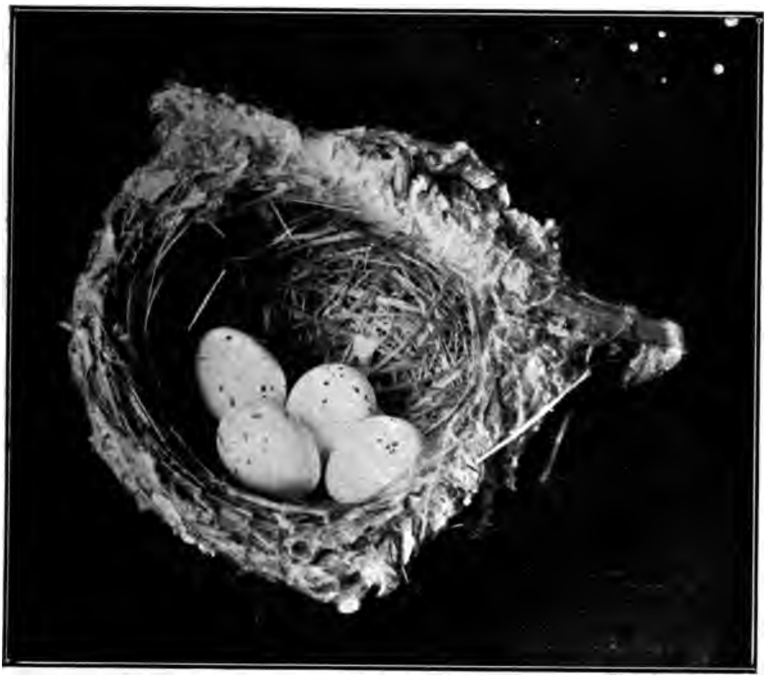


FIG. 19. Nest and Eggs of Warbling Vireo, *Vireo gilvus* Vieill. Photo by M. J. E

Though scarcely constituting a type, the nest of Audubon's warbler is somewhat different from other nests which it resembles. It is rather larger than that of the yellow warbler, and darker in appearance, assimilating more closely with its surroundings. Its outer appearance is much like that of the redstart, though it is so much larger that there is no likelihood of confounding the two. This nest is made of dark weed-stems, strips of weed-bark, gossamer, and fine dried grasses, with soft feathers and horsehair as lining material. The use of feathers in the inner wall serves to distinguish this nest from the work of the yellow warbler.

For neatness of structure and harmony of appearance, the nest of the yellow warbler is a noteworthy example. It is usually made in an upright crotch of small branches, from five to fifteen feet from the ground. The materials chosen are of a grayinsh color. The predominating substance is fine dried grass, woven together with downy fibers, shreds of weed-bark, fragments of gossamer, and horsehair. The peculiar feature of this nest is the neatness of the interior finish. Frequently one is found that is lined throughout with white vegetable material as smoothly as if satin or morocco were used.

As a distinct type, the nest (Fig. 19), of the vireos is interesting in several ways. The site is unique, being invarably a horizontal or drooping fork of twigs near the extremity of a branch, from six to twenty feet from the ground. It is a swinging cradle firmly attached by its brim, without motion in itself yet swaying with every impulse of the passing breeze. The outer wall of the nest is very loosely arranged in an irregular covering of fibrous shavings, strippings of bark, gossamer, and pieces of hornet paper. The bedding of the nest is fine dried grass of a wiry texture. The foregoing descripton is alike applicable to the nests of the red-eyed and warbling viero, the only representatives of the vieros in the Flathead region. The external materials of the nest of the red-eyed vireo is generally more loosely disposed, the cavity is somewhat larger, and the structure as a whole averages larger than the nest of the warbling vireo, otherwise no difference is observable.

In this locality the cedar wax-wing constructs a nest (Fig. 20), of an interesting type. It is generally placed near the top of a small evergreen tree, or near the extremity of a horizontal low branch of a larger evergreen. The foundation of the structure is a loose mass of dried grass and small twigs. The walls are made almost wholly of dark green lichen, pinned firmly together with pine needles and smaller twigs. Frequently the nest has a lining of fine wiry grass. This type of nest is characteristic of the cedar wax-wing in the northern evergreen forests.

One of the most abundant birds of this region is the lazuli bunting, the western representative of the familiar indigo bunting of eastern habitat. The nest of this bunting is made in low bushes, from two to five feet from the ground. It is a type in its simplicity, being made of coarse dried grass and weed fibres, lined with fine grasses and horsehair, the main elements being of a grayish white color. The walls are loosely woven, and the nest is rather large for the size of the owner.

The nest of the black-headed grosbeak is a type because of its loose arrangement and frail structure. The ordinary site is the top of a large, loosely-spreading bush, a small evergreen tree, or the top of a low thorn tree. In such situations the eggs can generally be seen from below, as the nest materials are so loosely woven that the bottom is comparable to a net of several folds to retain the eggs. The affair is made of dark-colored twigs and rootlets, and is usually lined with finer rootlets of a darker color, or with fine grasses of similar hue. Last season a nest of grosbeak was found lined with fine moss-stems of a reddish brown color, the effect being a very handsome nest. The nest is so frail that the materials readily fall apart, or the twigs drop away one by one.

The familiar chipping sparrow constructs a nest of simple yet original pattern. An outer wall of finer weed-stems, grasses, or lichens, and an inner layer of horsehair, are the essential features in the chippy's idea of building at all times and places. The outer layer is variable or may be lacking, but the horsehair is indispensable, and frequently the nest contains only this material. The chipping sparrow's habit of using horsehair has suggested its nikname of hairbird in many localities. Generally dark or black hair is used, but this season I found a nest in which white or gray hair was used, the only nest of the chipping sparrow thus finished that I remember to have seen.

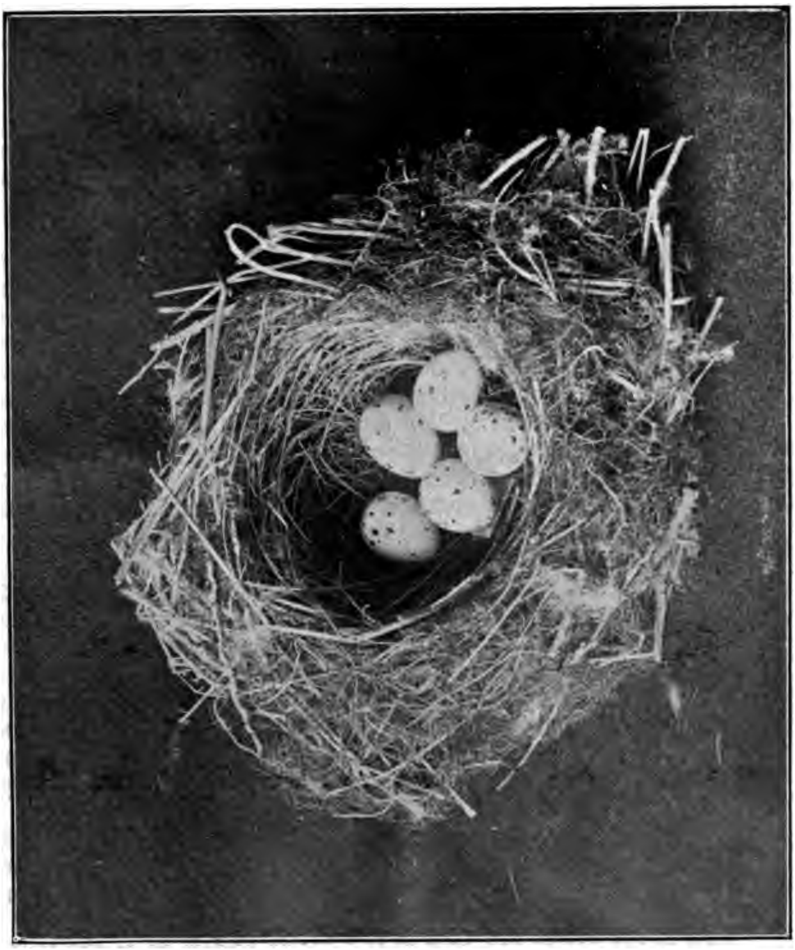


FIG. 20. Nest and Eggs of Cedar Waxwing, *Ampelis cedrorum* Vieill. Photo by M. J. E.

Another sparrow of this region, the western vesper, follows a plan of building similar to that of the chippy. The site is a depression in the ground, at the base of a tuft or small bush. There is generally an outer wall of dried grass or weed-stems, and a lining of horsehair. In many nests, however, the horsehair is lacking, fine dried grass being substituted for it, hence we see that the type is not so constant as that of the chippng sparrow. Moreover, the nest of the vesper sparrow is a very flimsy affair, held in shape chiefly by the cavity it occupies, and not likely to retain its form when removed from the site.

The nest of the black-headed jay is seen frequently in this region, along the mountain streams and lake shores. This nest is oftenest made in small firs, on horizontal branches against the main stem, from six to eighteen feet from the ground. A typical nest consists of an outer framework of coarse dried twigs, interlaid rather loosely. Within these is a layer made of coarse weed-stems and muddy moss or lichen. Internally there is a layer of coarse brown rootlets. One of these nests is about eight inches across at its top, and five inches high.

The nest of the American magpie is a peculiar structure, though interiorly it is very similar to that of its relative just noticed, the black-headed jay. The base is a mass of large twigs, which supports a basin of dried clayey mud from seven to ten inches in diameter and about six inches deep. Within this earthen bowl is an inner nest of coarse brown rootlets, frequently with a scanty amount of horsehair. Over the nest, at a height of a foot or more, is a thick canopy of dried sticks, forming a snow-proof covering. Around the sides is a lattice-work of stout twigs, frequently so closely interwoven that a regular opening is necessary for the the entrance and egress of the owners. Commonly, however, the birds enter through openings due to the loose degree of interweaving of the materials.

Among the nest-builders of this region, Wright's flycatcher next demands consideration. A typical nest is very similar to one of the yellow warbler, both in situation and construction. It is made of grayish fibers of weed-stems, shreds of bark, and gossamer, within which are woven small downy feathers and cottony materials, besides which a few fine grasses are frequently used as lining. The tiny feathers used in this nest aid in distinguishing it from the yellow warbler's, though sometimes a nest is found which is felted as softly within as some nests of the yellow warbler. See Fig. 21.

The woodpeckers, of course, nest in cavities which they make in the trunks of trees, at varying heights from the ground, and deposit their crystal white eggs on the bare floor of the cavity, making no attempt to carry material to complete the interior.

Most of the hawks and owls of this region seldom go to the trouble to construct a new nest, but usually take possession of an old structure made by some more industrious builder in a former season. The spirited little sharp-shinned hawk, however, makes a new nest each year, its habitation being quite typical. The site is low, two that I have examined in this region being each within eight and nine feet from the ground. The nest is a mass of twigs, having a very slight depression and no lining material to receive the handsome eggs which this hawk produces.

Among the water-birds of this region, the most characteristic nests are those of the grebes. These nests are made in the swamps, among dead and growing reeds, in water a foot or more in depth. The nest is a mass of black, decayng material, intermingled with which is some green material of the season. This mass of rubbish is anchored among the reeds, generally forming a low mound projecting about four inches above the water, and measuring from eighteen to twenty-four inches across at the surface of the water. The cavity is very slight, and generally contains a lot of loose stringy material like that in the nest, which can be hastily scratched over the eggs to conceal them when the owner leaves them.

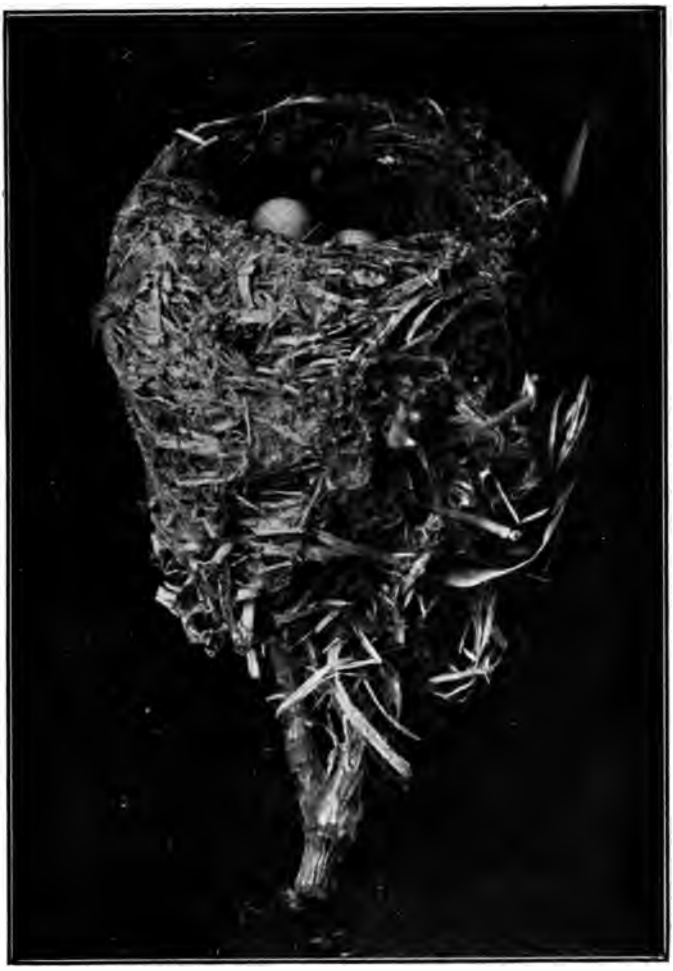


FIG. 21. Nest and Eggs of Wright's Flycatcher, *Empidonax wrightii*. Photo by M. J. E.

Animal Counterfeits.

Maurice Ricker. h. J. T

I have previously told of the marvelous adaptations of plants and animals. We have been duly impressed with the perfect harmony of adjustment and are prepored to examine into the more intricate relations existing between them. Let us keep in mind the universal struggle for food, the great loss of life in immature stages, and the tendency to variation. We believe that whatever variation tends to perpetuate the life of an individual, or to render it less liable to annoyance in procuring food, will prove of advantage to the race, since this variation tends to be transmitted to the offspring.

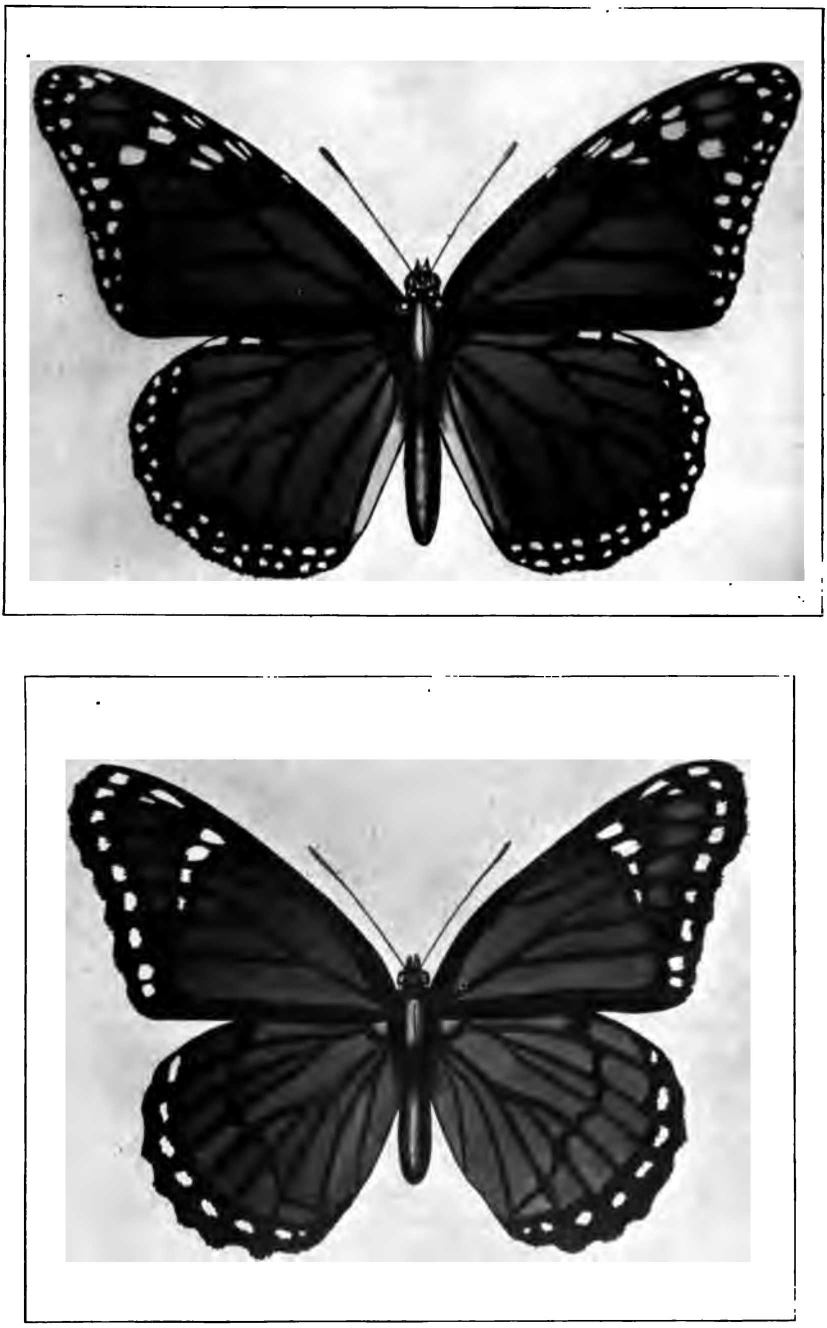
Truly, might an animal exclaim, "This is a world of shams." "Everyone is seeking to deceive." Aesop's fable of the "Ass in the Lion's Skin," is a tame story compared with the one we may see in nature any summer afternoon. For, in the fable, the ass masqueraded but for a day while in nature we find animals whose ancestors, for a thousand generations, have carried out their hypocrisy for a life time.

The simplest example, and one which every one has observed a great many times, is called protective coloration. Upon the success with which an animal can become apparently a part of the general landscape depends his very existence. The lessons we have all had when seeking some wild animal have fixed this principle well in our minds.

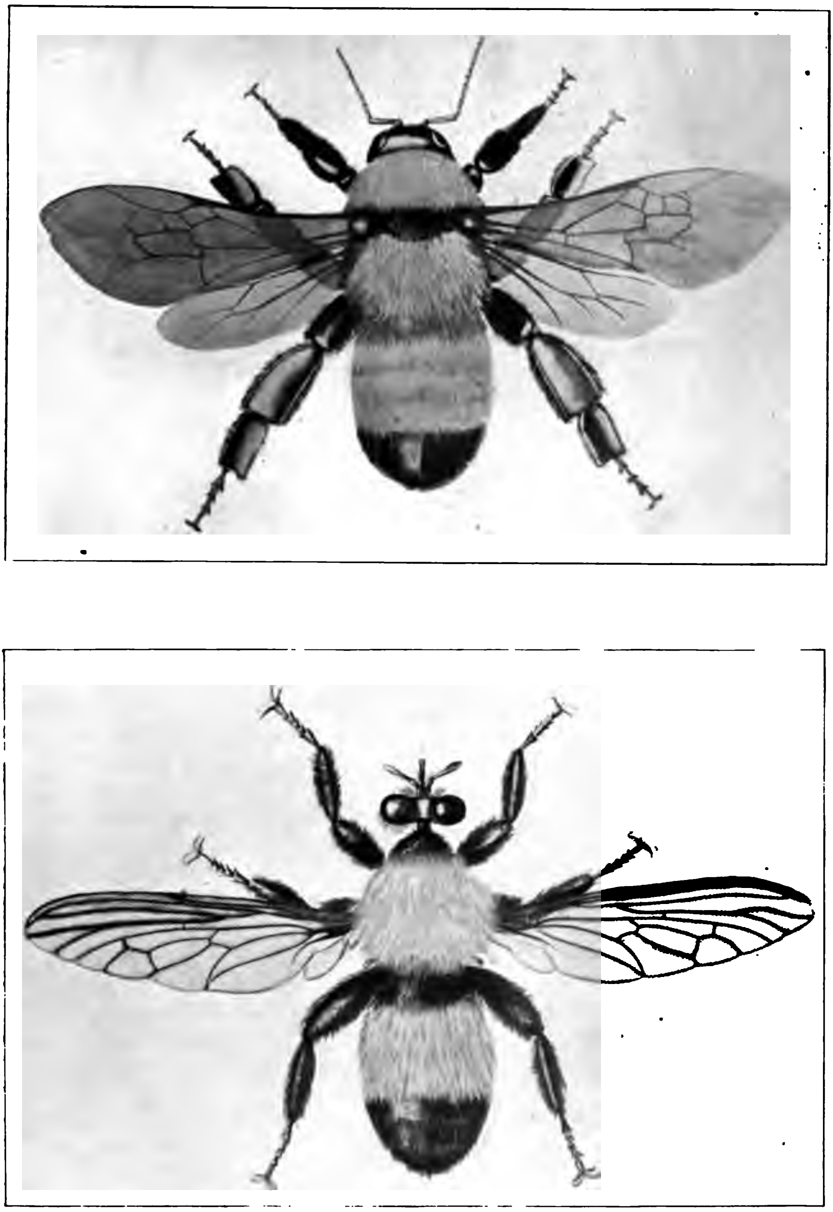
I remember once seeing a young spotted sandpiper on a rocky sandbar in a small stream. I went over to pick him up, when, as if by magic, he disappeared. In vain did I search and, for all I know, the little rascal is hiding there yet. He was no doubt sitting motionless among the rocks, and my eye was not keen enough to discern him among the light and shade of the pebbles. If animals are not wholly devoid of humor, what a good joke it must be—this game of hide and seek of theirs.

But it is serious business. It is in reality a game with the player's life at stake. If he wins he lives to perfect his art and practice his profession of a counterfeiter. If he lacks confidence in his own game and betrays by a move the fact that he is not a part of the inanimate landscape, he pays the penalty with his life. If through variation he happens to be more conspicuous than his type he stands a much greater chance of being picked up by his enemies. Thus nature would check a tendency to more conspicuous colors.

A few words on color in general may not be out of place. Scientists now find significance in nearly all coloration. At one time it would have been sacriligious to have found other reasons for nature as it is, than as a creation solely and wholly for man's pleasure. I, for one, do not believe that man's reverence for nature or nature's God is any the less deep, for what may be called a more modern view. The true dignity of man and his exalted place in the universe is not lowered by this conception



Mimicry of Anosia plexippus (upper) by Basilarchia disippus (lower). Photos from water color drawings by Mrs. Edith Ricker.



Bumble bee (above) mimicked by fly (below). Photos from water color drawings by Mrs. Edith Ricker.

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of the organic world. A hundred years ago they said the hills are clothed in green and the valley bedecked with flowers solely to please man's eye for color. The poet says that "Full many a rose is born to blush unseen, and waste its sweetness on the desert air." I take it that the relations of plant and insect life thousands of years before man's appearance on the globe were much the same as to-day, and that an intelligent understanding of these facts will add largely to man's enjoyment of nature. Is not the pleasure of intellectual insight into nature of even higher order than the gratification of the sense of sight and smell." So color must be studied with the good of the race always in view.

In general animals wear colors that harmonize well with their surroundings. This arrangement may serve one of two important purposes and sometimes both. The most obvious use is that of the case just cited, where concealment is most desirable and necessary for protection of the animal sought by stronger animals for food. The other case is easily explained in the case of the polar bear. He has no enemy but hunger and his coloraton enables him to steal upon his prey unobserved.

The advantages of protective coloration are still more clearly brought out by the examples of those animals which change their color with change of season. The Rocky Mountain goats live always on or near the snow. They remain white throughout the seasons but the ptarmigan changes to match the ground in summer and the snows in winter. The weasel and many other animals change their coat with the seasons.

We find in insects some of the most marvelous instances of coloration. It is well known that green larvae usually feed upon green leaves and brown larvae rest upon brown stems. The cocons of moths are sometimes wrapped in leaves and the naked crysalids of various butterflies resemble dried leaves. The common walking stick, as it is well called, while a common insect of the field is seldom seen owing to its almost perfect resemblance to the twigs upon which it rests. The measuring worms, as they are called, more properly the larvae of grometrid moths, have not only the color of the plant upon which they rest, but when disturbed they hold to the stem with their abdominal feet, and, stiffening themselves at an appropriate angle to the stem, look precisely like the petiole of a leaf or a broken branch. It is a truly interesting experiment to tap a plant upon which they are feeding and note how rigid they become and how perfectly they assume the proper attitude. After a few minutes they will slowly unbend and become living larvae once more. Who has not walked through a forest and seen the brilliantly colored catocala moth flit an instant before his face and apparently disappear when he alights upon the tree trunk? As interesting a disappearance is that of the coralwing locust who flies with a gaudy flash of red or yellow and drops into the dust in the road to all appearances as lifeless as the clods around him. It is often necessary to scare him up many times before you are able to detect the dust colored form crouching in the dust, ready for a spring. So we might continue to name hundreds of familiar cases of protective coloration among animals. Besides, especially those birds which nest on the ground are protectively colored. We have all experienced the thrill of seeing a nighthawk get up from under our feet. You may have searched the ground in vain for the speckled eggs laid so openly on some bare rock with the same lack of success that I have had.

I want here to mention some points not always understood. It is not supposed that the lower animals use cunning in their counterfeiting. We consider rather that they are unaware of the part they play. They certainly have no intent to deceive and are many times not conscious that they have any advantages in concealment. The chameleon changes color to suit the color of the substance it nests upon as nearly as possible, without conscious effort. By destroying his brain with a wire and then placing him on the colored backgrounds, this has been proven to be a reflex action.

The young robin instinctively remains in the posture I place him in, no matter how uncomfortable it may be. The nighthawk flops around and leads us away from her nest with no more thought than when she formed the blotched eggs which are so difficult to see on the ground. This leads up to a consideration of instinct and animal intelligence which must be deferred to another time.

Under the head of protective coloration are the many instances of warning coloration. Here the animal seems made for show and certainly intends to be seen. His colors stand out brilliantly; and as fitting actions accompany coloration we notice in this class of animals a disdain of concealment and often, in the case of flying insects, a loud buzzing noise. The bumble bee goes about its business and makes all the noise it pleases; in fact, seems to announce its coming.

As an example of warning coloration notice the orange or yellow banded bumble bees. If you are in doubt as to whether they need to conceal themselves catch one of them in your fingers and learn wisdom. If you need further experimentation next try the orange banded hornet. It may be difficult to teach one who has tried these experiments that these animals are well behaved, peace loving citizens of the insect world. If you stop to reason you will perceive that you were the aggressor in this instance and that you have hitherto carefully avoided thousands of these yellow or orange banded insects flying around with a buzzing noise. These insects are not armed with the intention that they are to use their weapons frequently. The occasional one who is imposed upon teaches the rest of the animal world to leave all similarly uniformed insects alone and as a rule they go on their way unmolested and to these colors owe their freedom from annoyance. Other insects like the brilliantly colored beetles and the Anosia butterflies are very distasteful to birds and their other enemies. Unless a bird inherits a suspicion against them he will soon get a bad taste in his mouth that will remind him for all time of its source. Certain caterpillars are likewise protected. Our common potato bug has few enemies after it hatches into the larva stage. If it were so fortunate with respect to its eggs it would no doubt exterminate the potato plant.

A very strangely marked blue frog of the tropics was placed before a number of cautious fowls. After a time an unsuspecting gosling took a number of cautious fowls. After a time an unsuspecting gosling took for some time shaking its head and evidently very sorry for its error.

Among mammals the skunk is a strikingly colored as well as a strongly scented animal. But why tell of warning coloration in a study of counterfeit? You say surely the bees are an honest self respecting folk. So they are, but we must understand what freedom from annoyance or extermination they enjoy and then we are fully prepared to comprehend the beautiful scheme by which nature protects her own from her own. Let us look for a moment at the **Anosia plexippus** (Plate L.) a butterfly of tropical origin, which migrates northward in the spring time, lays eggs for a spring brood which complete the cycle and migrate further northward. The fall brood migrate southward in September. There is no easier butterfly to raise from the egg which may be found on the common milkweeds. Why does this butterfly enjoy such a freedom of flight? It is found upon trial that birds forcibly fed upon the adult **Anosia** become very sick. It would seem that the birds have either tried the experiment or are warned in some way from doing so. They therefore never touch brown butterflies of this size with a black bordered wing bearing a row of white spots.

Let us now look at representative members of a widely separated genus, the **Basilarchias** (Plate L.) We find them to be generally purple in color with white or brownish markings. The common species of this genus in Montana has a broad white band on the forewings. In habit they are shy and flit from one bush to another.

One species of this genus differs radically from the others in coloring and habit. It is the species **disippus.** It is almost a perfect copy of the **Anosia** just described. It also has the habits of that insect. The early entomologists, who made the classification a matter largely of external appearance, very naturally classified the two together. In fact they are so nearly alike that they deceive everyone but the trained entomologist who looks beneath outward appearances. They differ in that the **Basilarchias** are edible when birds can be induced to try to eat them. This is doubtless a very rare occurence in nature owing to the perfect resemblance to the undesirable species.

Wallace states the conditions necessary in order to effect mimicry are follows:

1. The two species, the imitating and imitated, must occur in the same locality.
2. The imitating species must be the more defenseless.
3. The imitating species must be the less numerous.
4. The imitating species must differ from its allies.
5. The imitation is external only, affecting only external appearances.

As to the origin of such a species some think that it must have come from **Basilarchia astyanax,** the common species of the middle states, which is sprinkled with brown spots. It may be that certain individuals differed from the current stock in being nearly or entirely brown. A sudden variation to a widely different type is called a sport and occurs in all species. If the sport came near enough the **Anosia** in color to be mistaken by its enemies for an edible species, it would be likely to live to reproduce. From the eggs of such an insect perhaps only a few would resemble the parent but these few would stand the better chance of living and eventually would become distinct, owing their very existence to an accidental similarity of sports. Each generation tends to make the resemblance greater as the unprotected ones would be more likely to be eaten by hungry birds. We therefore call this a case of insect protective mimicry. It is probably the best case known. The manner in which the species arose teaches Darwin's great doctrine of the survival of the fittest and explains what he means by natural selection. Without this great key to the secrets of nature before the time of Darwin man was unable to explain many great biological problems, as for example the existence of related species and the enormous waste of life in arriving at maturity. The law of survival of the fittest solves to the satisfaction of many these great problems. The animal takes no conscious part in the great scheme of nature. It takes no thought as to how it is clothed or fed. The unalterable laws of the universe are at work upon it, but it need not know or care.

Another line of counterfeiters of very great interest are the numerous unarmed insects who wear the uniforms of the wasps or bees. We need not go into the subject very deeply since it is almost a parallel case to the one given at length above. It is of obvious benefit to a defenseless fly to wear the yellow sash of a bee and thereby escape attacks of enemies which fear the sting of the bee. Many such can be found on the flowers almost any sunshiny day in summer. There is a family of flies that especially enjoys this disguise and feeds on the nectar of flowers, sucking through their long slender probosces. Since they aid in cross-fertilization as much as would a true bee I do not know that we should condemn their deception too severely. We may look upon them as harmless masqueraders.

While we admire the cunning in nature which protects so many helpless and innocent ones from injury, what shall we say of those rascals who wear the uniform of the bee, not for protection to themselves, but for the purpose of being better able to steal upon their victims. Many a tragedy in insect life occurs in about this way. A strong two-winged fly looking very much like a bumble bee in size and color and differing slightly in the buzz of his wings alights on a clover blossom and settles down to await a victim. Soon a heavily laden bumble bee alights upon a neighboring clover head wholly unsuspecting the counterfeit bee on the other blossom. Like most honest people he has little time to harbor suspicion of evil from one of his own kind. The villain squares himself for a jump through the air. A second later he alights upon the back of his victim. He holds the dangerous abdomen with its deadly sting securely in his bristling legs, and punctures with his strong beak the shiny armor on the bees thorax. In a minute it is all over, and, dropping the lifeless victim, he begins to clean himself after the manner of the fly family. I have his picture for the rogue's gallery. (Plate LI.) See how much like a bee he is even with wings and legs spread to show the differences. Gibson has told the Syrphus fly story especially well in his "Sharp Eyes." There is a large number of the robber flies who mimmic for aggressive purposes.

Why are all small boys afraid of a dragonfly? The boy believes the real mission of the dragonfly in life is to feed snakes and sew up the eyes, ears or mouths of small boys? Catch a dragonfly or a cranefly or any other insect with a long abdomen and how does he act? It turns the abdomen around wasp like and pretends it will sting. The boy believes the dragonfly will sting. Later in life he learns that the insect is perfectly harmless.

Among caterpillars there are many amusing instances of larvae being provided with means of putting on a horrid face or swelling up in such a way as to strike terror to the heart of all but those who know his ways. Snakes coil as if to strike, dart out their little forked tongues and look very vicious. Butterflies have big eyes on their wings giving them the appearance of larger and more ferocious animals. There are thousand of instances in which the animal, while perfectly harmless, deceives the uninitiated into believing him a very ferocious beast.

I sometimes think of the swagger and bluff of the biped coward who assumes the role of "a bad man." He may be pretending to be just spoiling for a fight. The fact is wild animals put up what we call a bluff. Some will fight a wicked battle when opportunity offers, but in general they want to be let alone. The rattlesnake sounds his warning. His rattle serves to protect him by frightening away more enemies than he fights. The armed bees carry warning colors and wish to be let alone. The mosquito seems an exception to this rule, but only the female, seeking nourishment for her brood that is to be, bothers man. Another series of counterfeiters that I must expose are those who by some display simulate the food of animals and the victim discovers his mistake just in time to be himself eaten. The kinglets and fly-catchers among birds as well as certain fish display traps of this kind. The term alluring coloration is appropriately applied to this class.

The fish bury themselves in the mud and by moving certain appendages lure smaller fish to believe that there are edible worms to be had in that vicinity. Upon attempting to obtain them they are themselves eaten.

The crowned kinglets and the tyrant fly-catcher spread a crest of orange or ruby feathers in a way that attracts flying insects to the supposed flowers. I have observed the ruby crowned kinglet engaged in attracting insects by this device. It seems to work well in early spring when both flowers and insects are scarce.

I have purposely reserved to the last an illustration in protective coloration that excells them all in the wonderful detail with which it is worked out.

Sir Alfred Russell Wallace, the naturalist who shares with Darwin the honor of discovering the theory of natural selection, on a visit to Borneo was told of two strange butterflies. One grew on trees and could be occasionally found apparently attached to the limb. The other was a brilliant blue and orange insect that totally disappeared when it flew into the shade of a tree. As you have already discerned, Wallace soon found them to be the same form and he gave to the world the example of the Kalima butterfly.

Words can not adequately describe this marvel which must be seen in its natural size and color to be appreciated. The wings fold in such a way that the tips of the hind wings touch the twig, giving it the appearance of an attached petiole. The outer border resembles that of a torn leaf. Running up the middle of the folded wings is a dark line which represents perfectly a midrib. It has a raised appearance given by an artistic rendering of light and shade effects. One can scarcely believe that it is an effect produced by flat scales.

Still more wonderful is the way in which the venation of the leaf is brought out. The natural color of the veins is heightened in the two quarters where wing veins would harmonize with leaf veins. Still more wonderful is the almost total suppression of the wing veins in the other two quarters where wing veins would run across leaf veins; but in their place, to carry out the deception, it would seem, to the minutest detail, a series of shadowy scales take the direction of leaf veins. Thus the pattern of leaf venation is completely represented. The leaf insects, leaf carrying ants, and all the long list of nature's deceivers, must yield the palm to the magnificent Kalima butterfly, the prince of counterfeiters of the animal world.

Thus nature strives to protect her own. The key that unlocks many a mystery in animal adaptation is not always easily found. Working upon the hypothesis that animals have come to their present forms and colors through adaptation to their environment we believe that there is sufficient reason for all phenomena. We have the privilege here of working in nature's own laboratory where as yet the hand of man has hardly disturbed the balance which has been brought about by years unnumbered. A few years more and where can we find a spot on this hemisphere where man has not turned the plant and animal world topsytruvy by destruction of native species and the introduction of foreign ones. Let us then improve our opportunity.

The Forest and the Prairie.

Harry Nichols Whitford.

Plants may be divided into two groups, herbaceous and woody. In the former the part above ground dies in the unfavorable season; in the latter the part above ground does not die annually. These two general forms may be subdivided. For example, the herbs may be divided into annuals and perennials, and the woody type may have the form of the shrub, vine, or tree. The climate of the greater part of the state of Montana is more favorable to herbaceous than to arboreous plants. The portion of the state east of the Rocky mountains is primarily a region where the moisture conditions will not permit trees to grow. However, there are certain parts in which the rainfall is sufficient in quantity to favor the growth of trees. The northwestern portion of the state, embracing the Flathead valley and the mountains on each side, is an extremely favorable place for the production of forests, but parts even of the Flathead valley are incapable of supporting trees. On one side of the valley, the prairie side, the rainfall is less than sixteen inches. The forest side has a rainfall of about twenty-one inches.

In order to understand why trees are confined to certain regions, it is of extreme importance to know what functions they perform and how the conditions in which they grow affect the work they do.

The tree absorbs water. It does this through its root system, and the greater the root system, the greater the power of absorbing water. The tree with an extensive and deep root system can live in drier situations, other things being equal, than the tree with a shallow root system, for its roots come into contact with more water in the soil, and in some cases may reach to the underground water level. In the latter case it is not so dependent on the amount of rainfall. Where the underground water level is near the surface, trees with shallow roots have as good a chance to get water as trees with deep roots. To illustrate these two points, compare the **bull pine** and the **silver pine**. The former has a deep and wide spreading root system. It can grow in much drier soils than the latter, which, on the other hand, has a shallow root system. It is, as a rule, confined to those situations where there is a great deal of water in the soil. Again, the root system of a tree serves to hold it in place. Those trees with deep root systems cannot be blown over so easily as those trees with shallow root systems. In the Flathead valley it is not an uncommon thing to find silver pines lying prostrate with almost their entire root system exposed, while other trees in the same situation are able to resist the wind because they have deeper root systems.

The tree is using water continually for three purposes:

1. Small quantities are used to supply the new growth that is added to the tree annually.

2. Small quantities are used in the manufacture of foods, such as starch, sugar, and other carbohydrates.

3. Large quantities are used to supply the loss by evaporation that is continually going on.

Analysis of the last process will show what role it plays in the distribution of trees.

The evaporation of water from plants is known as transpiration. The water taken in through the roots is carried through the stem to the leaves and other superficial parts of the plant, whence it passes into the atmosphere as vapor just as water in any moist object may. Other things being equal, the greater the surface a plant exposes to the atmosphere, the greater the amount of water given off. The tree, because it has a greater surface exposed than other forms of vegetation will give off more water. A birch tree with about 200,000 leaves has been estimated to give off from 350 to 470 pints of water on a single hot day. The amount of transpiration is regulated in a great measure by the conditions of the atmosphere. If the atmosphere is damp there is less transpiration than when the atmosphere is dry. Again, on a windy day the tree will give off more water than on a still day. Other things being equal, more water will be transpired on a warm day than on a cold day. Indeed, any condition that will affect the evaporation from wet objects, like clothes on a line, will affect the transpiration of a tree. In the growing season a tree like the birch will give off more water than a pine or fir tree of equal size, for the birch exposes to the air more leaf surface than the pine or fir; also its leaves are more delicate in structure than their hard needle-like leaves. Therefore the pine, other things being equal, can live in situations, which are drier during the summer months than can the birch. However, during the winter season the birch having shed its leaves exposes nothing but bare limbs to the atmosphere, so transpiration is much reduced. On the other hand the pine holds its leaves and has as much surface exposed during the winter as during the summer, and it is therefore in more danger then of losing water than a tree without any leaves. For even though the loss be checked by cold weather, absorption is checked also, because the colder the ground, the less the absorption; and if the ground be frozen around the roots, little or no water can pass into the tree.

It will be seen from the above that there is a relation between the intake and the outgo of water from the tree. If the tree is to survive, absorption must be greater than transpiration. As soon as it is equal to or less than the transpiration, the tree is in danger of drying out. In those climates where the rainfall is not sufficient to keep the soil wet enough to maintain this inequality between absorption and transpiration, trees cannot exist. But even in prairie regons there are places where there is sufficient water in the soil, as is the case near bodies of water where the underground water level is near the surface. This, no doubt, accounts for the presence of trees along streams in climates where the rainfall alone is insufficient to maintain trees.

Trees, being green plants, manufacture starch, sugar, and other carbohydrates. They do this in all green parts and therefore mostly in the leaves. Water taken in through the roots is united with carbon dioxid absorbed from the air through the leaves. In the presence of light, by an unknown chemical process, the carbon dioxid and water are changed to a carbohydrate and oxygen is given off. Of course, light reaches the trees only in the day time. This process needs a certain amount of heat, but small quantities of starch can be produced by trees with evergreen leaves even at temperatures slightly below freezing. There are probably many warm days during the non-growing season when considerable quantities of carbohydrates like starch and sguar can be made. Especially would this be true in the early spring and late fall. The trees with broad leaves can manufacture more food during the summer months than trees with needle leaves; for they have more surface exposed to light, and the greater the green surface, other things being equal, the greater the amount of food that can be formed. But the time for the making of food by these broad leaved plants is practically limited to the time of the year during which they have their leaves. As soon as the leaves are shed little or no food can be produced. Thus, while they have an advantage over the evergreen trees during the summer, the latter, because they can work more or less during the whole year, may manufacture more food in a year than the former. This is more likely to be the case in high latitudes where the temperature of the summer months is comparatively low, than in more southerly climates. Especially is it the case in climates with a more equable distribution of the heat throughout the year, the summer months having a comparatively low mean and the winter months a comparatively high mean. Such is the climate in the Puget Sound regon, where conifers are developed best in America. In the Flathead valley the distribution of the temperature throughout the year is not so equable as it is in the Puget Sound region, but it is more so than in a similar latitude in the eastern part of the United States. The evergreen trees reach a more luxuriant development in this valley than anywhere in the east, but of course are not so luxuriant as in the Puget Sound region.

The greatest danger that trees have to meet is an excessive loss of water. They are excluded from those climates that have little rain fall. A prairie vegetation can exist in these places because the plants growing here have met the danger of drought better than trees. There may be climates where the rainfall is so little that even prairie plants cannot thrive; then a desert is the result. There is, however, no true desert region in Montana, although in places it approaches the desert condition. These regions are known as the **great plains**. In such regions the sage brush is a characteristic plant, although it is not so conspicuous an element there as in the more desert like regions.

When the clmate of a country makes conditions favorable for a certain **form** of plant life, then that **form** gives character to the landscape. If the grass and its associates give character to the region, then there is **a prairie formation.** If trees give a tone to the landscape, then there is **a forest formation.**

It may not be out of place to compare the relative capacity of these two forms of plants (the grass form and the tree form), to meet this danger of too great a loss of moisture. The danger to plants becomes greatest during the dry summer months and during the winter. As already shown, during the winter months the cold soil is not favorable to absorption, and if the plant be subjected to evaporation then, it is likely to transpire more than it can absorb. A cold soil then acts in a measure like a dry one, and the plant is in danger of excessive loss of water during the winter as well as during the dry summer months.

The herbaceous plants meet the danger of transpiration and freezing by dying down to the ground during the unfavorable season. The annuals of course are tided over this season in the form of seeds, and the perennials, beside seeds, have also underground stems. The latter, because they are protected by the soil, are in little danger of drying out. The woody plants, on the other hand, are exposed to all the extremes of winter. All trees are protected by their bark. In the young twigs this is not so thick, and hence these parts are more exposed than the older parts with heavy bark. So it is with the seedlings; for, although not so exposed as the older trees, the seedling stage of a tree is the most delicate one in its existence. If the dry season comes on before its root system is well developed, the seedling is very likely to perish. The seedling is subject to other dangers that will be mentioned in another connection. Those trees that shed their leaves are not so exposed during the unfavorable season as those that have their leaves the year round. Even the trees without leaves may be winter-killed. On the whole, then, herbaceous plants are less exposed during the dry and non-growing season than the trees.

Fires are detrimental to all vegetation, so it will not be out of place to compare the two forms with regard to their powers in resisting fires. A fire sweeping across the prairie may burn the surface clean of vegetation, but seldom if ever injures the underground parts. As soon as the season permits, the grass will spring up from these underground stems. Trees that have the power of developing suckers from roots will be protected in the same way. But few conifers have this power. However, the bark of old trees is often a protection against fires. The bull pine, Douglas spruce and western larch have thick bark and are protected in this way from fires that are not too intense. Young trees, however, succumb even to light surface fires, so acres of young trees may often be destroyed by fires that will not injure the older trees. The perennial herbaceous plant, then, has greater powers of surviving fires than trees.

Again, grazing animals are injurious to vegetation. The perennial grass is protected, because, when the top is eaten off, the under ground part is usually uninjured. Of course, if the above-ground green parts are eaten off so frequently that they have no opportunity to manufacture new food, the plant will be killed, and when the food stored in the underground stems is used up, then the plant will starve. Hence close pasturage is dangerous to the grass form. However, other forms of herbaceous plants that have an objectionable taste or are covered by spines or prickles will be avoided altogether by the grazing animals, or eaten only when nothing else is available. Sheep are the most destructive animals to pastures. The grass type has an advantage over some other forms of herbaceous plants in another respect. The growing region of a grass leaf is at the base, often below the surface of the ground. This part is less likely to be injured by fires or by grazing animals. As soon as the danger is passed, growth is resumed if the other conditions are favorable.

Young trees are subject to destruction by grazing animals. Especially is this true early in the spring, in the late fall, and in winter, for then there is often little to eat. Trees with needle-like leaves are protected more or less in that the needles, acting as prickles, are disagreeable. Yet even the shoots of conifers are often eaten. Young trees of bull pine and Douglas spruce have been found thus injured by cattle. Herds of cattle and sheep kill many trees in the young stages by trampling them. The older trees are less likely to be injured by grazing animals than the younger. The most important growing parts of trees, unlike that of the grass leaf is at the tip of the young shoot, and as this is the most tender as well as the most exposed portion it is likely to be eaten, by which the tree may be damaged or killed.

From the above it will be seen that the young tree is more subject to drought and is more likely to be destroyed by fire and by grazing animals than the perennial grasses and other herbaceous forms that grow in the prairie. In the drier regions, then, the prairie forms can exist where trees cannot, and even in regions where the moisture is sufficient to make tree growth possible, the occurrence of fires and the presence of grazing animals may favor the prairie rather than the forest. Of course, the forests that border on the prairie are open and prairie plants can exist there, but where the forest forms a heavy canopy, nearly all grasses are excluded, for as a rule, they require more light than they can get in the deep shade of the trees.

It should be emphasized that the seedling stage is the most critical period of a tree's life. Probably many trees could exist in drier regions than those in which they are found, if they could survive the juvenile stage. Especially would this be true of those trees that have deep and widespreading root systems, for they might later be able to get a sufficient supply of water from the soil to supply the excessive loss by transpiration. A number of successive favorable seasons no doubt permits some trees to be established in places where otherwise it would be impossible for them to get a start.

Another factor that is against tree growth is the prevalence of wind. Of course, occasional violent storms may destroy forests. But since on a windy day there is more water given off than on a still day, even moderate winds may be prohibitive of tree growth whereas the occasional storm only partially destroys it. Because this factor is not so obvious, it is often overlooked. Even if the rainfall is sufficient to support tree life, in regions of excessive wind trees are often absent. A good sample of this is found in contrasting the two sides of the Rocky mountains. At the east base of the mountains where the Great Northern Railroad crosses, there is a rainfall of twenty inches or more, with little or no tree growth. The west base in the Flathead valley with a rainfall of approximately twenty inches bears a luxuriant forest growth. In the former situations, the winds are excessive. In the latter, they are neither so frequent nor so strong.

From the above it will be seen that the main cause for the absence of trees in a greater part of the state of Montana is the lack of sufficient moisture. In some places, however, where there is sufficient moisture, winds, fires, and grazing animals may prevent the growth of trees and thus favor the prairie.

Montana Shells.

NATURE STUDY LESSON.

Morton John Elrod.

The state of Montana is not very productive of conchological specimens. The conditions are all against shell growth. The rivers are rapid, the water quite soft, and food in the rivers scarce. The large lakes, as Flathead lake, contain clear, cold water. They are usually deep, with rock bottoms, and surrounded by mountains with steep slopes. The marshy, stagnant parts of the lakes are usually small. The mountain sides in summer become dry and parched, except in protected portions and along streams. Great stretches of plain are without moisture for a portion of the summer, drying up almost every living thing that cannot move to the water-courses. The days are hot, the nights cool. In this mountainous state, where very little soil is lower than 3,000 feet above the sea, the air is dry and evaporation rapid. A passing rain cloud may leave considerable moisture, but it is soon taken up by the parched earth or evaporated if left on the surface. Stagnant ponds with decaying vegetation are few and confined to the vicinity of a few rivers. Even such ponds usually become dry each summer.

Most of the valleys were former lake beds of greater or less extent. As these lakes have been drained, they left swamps in which rhinoceroses, camels, three-toed horses, elephants, titanotheriums and other beasts became mired, their remains being buried for long ages. These swamps have dried up, and the waters have become more widely separated, now occurring as deep mountain lakes, or larger lakes, which are mere expansions of rivers. Such isolation must have caused the separation of shells of a species which naturally would take different lines of development. Accompanying this gradual separation of waters we might expect a region of moisture on the land adjacent to the lakes, giving suitable environment to the land snails.

As a result of the above conditions, we may expect great variations in adjacent regions, where the barriers may be sufficient to cut off all communication. There is very little doubt but that the isolated lakes in Montana and the northwest will produce interesting variations. But the sparsely settled country and the small number of collectors make the work of collecting and studying very slow.

The lack of lime in the waters of the state in considerable quantity is another element contributing to the paucity of shell life. Specimens taken from water invariably have thin or frail shells. Some are exceedingly delicate. The land forms, although not numerous in species. have thicker and heavier shells, affording much better protection. One species of slug, without a shell has been taken, but in small numbers.

In considering the above conditons it is apparent that collecting living shells is confined largely to the rainy season, i. e., the spring and early summer. While this is particularly true of the land species, it applies also to water forms. The pond inhabiting animals in spring are given more extensive territory, thus increasing the food supply and furnishing better opportunity for the development of the young. The rushing waters of the rivers, except in shallow and swampy areas along shore, are almost destitute of shells. In the western part but one bivalve is found in the sand bars of the rivers, the common black clam, **Margaritana margaritifera** L. In the eastern part, tributary to the Atlantic, two **Unionidae** are recorded, **Anodonta plana** L., and **Anodonta ovata** L. In each case only the young were taken. Three other small bivalves, to be found among the vegetation of ponds, have been collected, one from the western and two from the eastern part of the state. It is thus seen that the total list

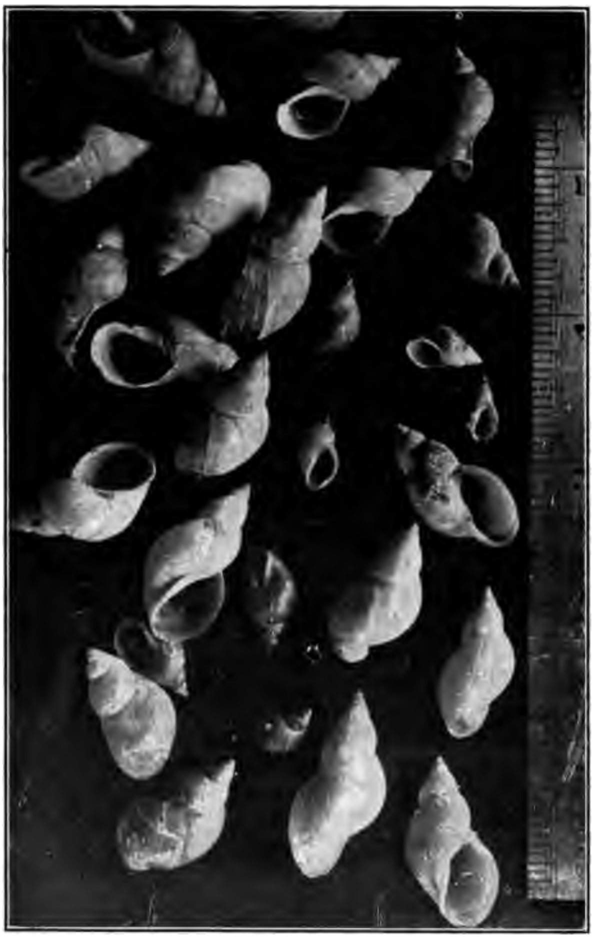


FIG. 22. *Limnaea palustris*, the commonest fresh water shell.

of bivalves inhabiting the waters of the state at present numbers but five species.

In most sections of the state rains are more or less constant in the state from early spring until the last of June. In May, June and sometimes early July, land forms may be hunted successfully. After this it is rare to find living animals except in very limited areas around lakes, ponds, or water courses. It is not uncommon to find bleached shells lying out in open and exposed places, but they are usually of one species, **Pyramidula strigosa** Gld., or some of its numerous subspecies or varieties.

To secure shells for the sanilery for class use is not exceedingly difficult, although they are not to be picked up at random. The water inhabiting species may be sought in shallow ponds, among the decaying or living vegetation. To secure them requires a pair of rubber boots, if one does not wish to have wet feet, and some form of a net for dipping them out of the water. The species in greatest abundance which is most likely to be taken is a small gastropod, with tapering spire, **Limnaea palustris** Muell. (Fig. 22). It is found throughout the state, may usually be had in abundance, and is not difficult to keep in the school room or laboratory. With it is likely to be had the smaller and more delicate **Physa**, with left handed turns in the shell. With these specimens in a vessel of water with suitable food a fund of information relative to their habits, movements and life may be secured. They will prove easy subjects for genuine work in nature study, and a large number of persons may carry on original observations. Other smaller species may be had possibly by sifting fine sand and separating the few shells to be had. I have kept many of these minute animals in vessels for months, and they have multiplied and done well. Those I have had were the diminutive **Pyramidula striatella** Anth., **Physa ampullacea** Gld., and **Limnaea palustris** Muell.

The land species must be sought in damp places. My most successful hunts have been in June on rainy days, although they may be had earler than this. It is usually necessary to search among the weeds and underbrush of the timber along the water courses or ponds, or in the damp canyons and gulches on the mountain sides. I distinctly remember several days in the Mission mountains where specimens were gathered. It necessitated crawling around on hands and knees among rank and dense vegetation, while rain was falling in torrents. While this was very disagreeable, it was the time when snails were active. Even when abundant they are difficult to find, owing to their color. They very much resemble the leaves and dead wood over which they crawl in search of food.

The snailery must be kept neat and clean, for snails are dainty creatures, and will not thrive in dirty cages. The water species will need occasional fresh water. The water of Montana's lakes and streams is so free from mud and silt, as a general rule, and so full of oxygen, that changes need not be made often. Once in two or three weeks will probably suffice if the vessel be large enough to hold a gallon or more. Water vegetation should be supplied, which will not only furnish food for the

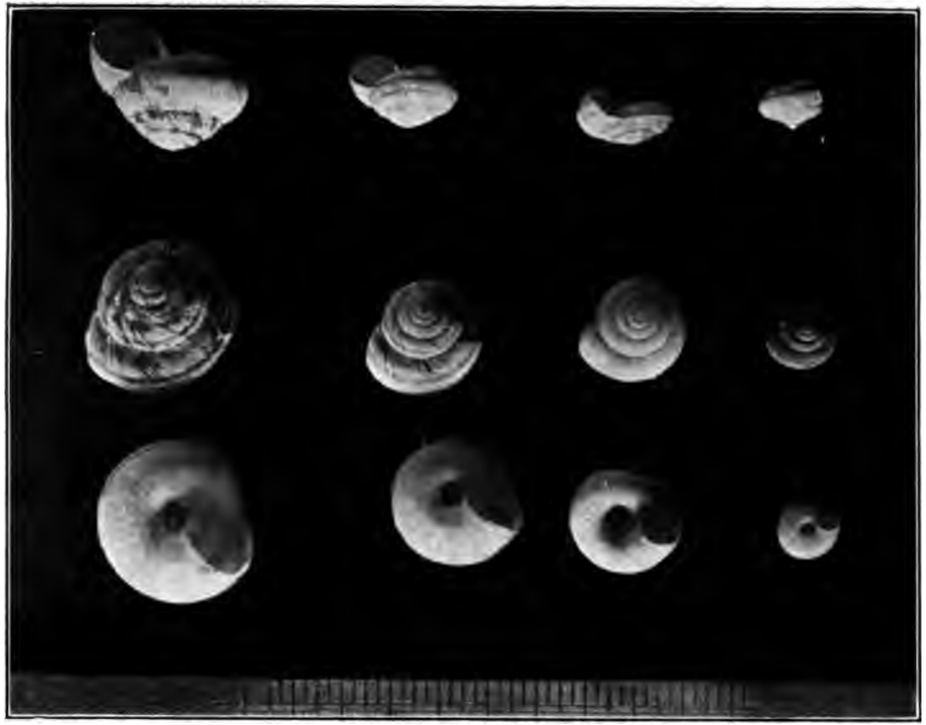


FIG. 23. A series of shells showing the varieties of Pyramidula strigosa due to high altitude. The largest, to the left, from McDonald Lake, altitude 3,300 feet. The next size, from Tobacco Root Mountains, east of the main range. The third, from the Bitter Root Mountains, altitude 5,000 feet. The smallest, from McDonald Peak, altitude 8,000 feet. Photo by M. J. E.

animals, but will also by its growth supply oxygen for their needs. I discover that pond scum may be kept growing all winter if placed in a south or west window for sunlight. Of course, water species may be kept in winter, when it will probably be found impossible to keep land species. In spring and summer the land snails may be kept in a suitable cage, and with a small amount of care and trouble in supplying food and in keeping the cage clean they will amply repay for the trouble. Pupils will find them interesting, and with a few suggestions will be able to make many valuable observations, and thus get true nature study lessons, a study of the living specimen whose habits and natural peculiarities may be known first hand.

The land snail most aboundant in the state is **Pyramidula strigosa** Gld. It is found abundantly west of the Rocky mountains at all altitudes from the lowest elevations to 9,000 feet. The shells found may easily be referred to several varieties. Figure 23 shows their general appearance. The shell is rather thick and heavy, recognized by two dark bands, one of which extends into the spire for several whorls. Closely related to it, and often associated with it, is **Pyramidula solitaria** Say, but the latter is more earthy, with darker color, a trifle flatter, and with broader bands, not extending into the spire. **Solitaria** is less common, and is not yet reported from east of the range.

Pyramidula strigosa has been taken by us abundantly in the western part of the state. It has been found on the slopes of many mountain ranges in the state. It has been taken as far east as Lewistown. It is a Rocky mountain species, and is so variable that conchologists despair of bringing the numerous subspecies and varieties into systematic relations which will be satisfactory. At two places in the Mission range, Sinyaleamin and McDonald mountains, it has been found at high altitudes, as explained in "A Biological Reconnoissance in the Vicinity of Flathead Lake." The lower snails are large and fine looking. The higher ones are very small, greatly reduced in size, and have very hard conditions to fight against in the struggle for a living. While the species is apparently of western origin, its presence at Lewistown shows that it has crossed the range, and is slowly making its way eastward. This is the second species, according to our studies, that has crossed the main Rockies, the other being a dragonfly. As there are seven species found in the state on both sides of the main range it is apparent that they have crossed the range in some way. As **P. strigosa** has been found at elevations up to 9,000 feet it seems reasonable to suppose that it was not carried over by some larger bird or animal, but crossed over by its own wanderings.

Several hundred duplicates have been collected, and two or three will be sent to any teacher of nature study, so long as they last, if postage accompanies the request for them.

It is needless, in this lecture, to atempt giving a list of the sixty species found in the state, twenty-five of which have been found west of the range, with forty-two from the east side. A list may be found in Bulletin University of Montana, Biological Series No. 3, pp. 170-174. Teachers who wish shells identified may send them to the writer, who will name them without charge. For much work in nature study a name is unnecessary, but it is very desirable. There are no keys available for identification of western species.

It will be seen from the above that the molluscan fauna of the west end of the state is entirely different from that of the east end, but seven being found on both sides of the mountains. As very few collections have been made it is very desirable that material be secured from various sections, and correspondence is invited on the subject and specimens very much desired. If teachers will suggest to pupils the desirability of gathering a few specimens the boys will probably bring them if they are in the neighborhood.

If the animals die, or if it is desired that they be killed so the shells may be used, the process of cleaning the shells and removing the dead animals is very simple. The shells containing the animals are dropped in hot water, and left for a few minutes. This quickly kills the animals and loosens them from the shell. The soft parts may then be removed by a bent pin or a piece of small wire bent at an angle at the end. Perfect specimen may then be made by washing out the inside with a pipette or small syringe. By gently rubbing the outside with a tooth or nail brush and water the outside may be shown off to best advantage. Such shells will ornament any school room or cabinet of collections.

Some of the suggestive points to which attention should be called may now be given.

Habitat. This includes the natural home, whether in water or on land, in the open or among dense vegetation. If among rocks the nature of the rocks should be determined. Shells found in water will suggest running water, sand banks, rocky bottom, shallow ponds, lake swamps, cold springs, or some other varying condition. Every phase of the environment should be noted, and suggestions thrown out for the purpose of having the pupils secure the information individually.

Movements. These may easily be watched, if specimens are kept in the snailery. It is very essential that the conditions in which the snail is placed should be as lifelike as possible, so as to be able to study movements that are natural and not forced. The animal may be watched while crawling around over the vegetation or along the sides of the aquarium. The use of the tenacles, the protrusion of the body from the shell, the withdrawal into the shell in times of danger, the action of the creeping foot during progression, and the movements of the mouth in feeding, all should be noted if possible.

Color and markings. Dead and bleached shells are not of much value, but are better than none. From them few conclusions may be drawn except as to size and shape. Teachers who understand the theory of protective resemblance will find shells suggestive of many things to which reference may be made. Those who do not understand it should make haste to consult some good zoology and discover its meaning. Shells generally resemble the surroundings so closely that they must be sought closely. I have frequently tried the experiment of searching a given spot carefully, to be followed by a second person who will see how many I have missed. A new spot is chosen and the order is reversed. Rarely will the second person fail to find some overlooked specimens, so closely do they harmonize with their surroundings. This blending of colors applies with almost equal force to the species living in water. Markings may refer to spots or bands on the shell, or to the indentations on the surface. This latter may be coarse or fine, deep or shallow, numerous or few. It may be possible to count the number per inch or millmeter, and thus determine points of variation.

The Spiral. This may be right or left handed, dextrose or levulose. Most shells are dextrose. If shells are in quantity each should be examined carefully to see if perchance an accidental specimen may be found the reverse of the ordinary. Such cases occur. Some species have the shells left handed, turning opposite to the hands of a watch. Each should be examined. The number of turns in the spiral should be counted. A means should be devised for determining the fractional turn at the last, as it is very likely to result in a fraction. By making count of a series variations will be found and a mean established.

Diameter and Depth. Adult specimens should be used. Three straight edges are necessary, one of which should be a finely graduated ruler. Place the shell against the ruler, and put the two remaining straight edges on either side, also against the ruler. The reading may be taken from the ruler directly. With a ruler and two square blocks any number of shells may be quickly measured. By turning the specimen measurements may be made in different ways, and variations noted. It is understood that the value of such work to the pupil depends largely on whether it is done **for** him or **by** him.

Variations. In a mountainous region shells of a given species from different localities or altitudes will show many variations. In fact, not two shells from any place are exactly alike. By noting the above points many lines of variation may be noted. It is possible to determine the direction toward which the species is tending; i. e., it is becoming thicker shelled, with deeper markings, broader bands, fewer turns to the spire, less width and depth, smaller in body, or the reverse. All such observations afford food for reflection, and are excellent mental stimuli. As this is the main thing sought in nature study work the observations should be encouraged by each individual, and not by the class as a whole.

Food. Few suggestions need be given on this. In the snailery different things must be tried. Daily observations may show whether land forms eat living or dead leaves, decaying wood, wet or dry leaves; whether water snails eat living plants or decaying material in the water, or living animals. All observations should be carefully recorded, and at stated times notes may be compared.

Enemies and Unfavorable Conditions. Drouth kills most land snails. Those living in water have no doubt many enemies about which little can be determined. Permit some shells to become quite dry and watch their actions. Notice the film across the shell to prevent evaporation. Other enemies to land snails are rodents, including mice and squirrels. If broken shells are found, examine carefully to see if the break is by accident after death, as by washing among rocks, or by an enemy before death. This must be determined by the position and character of the opening, as also by its recurring in a given manner. Observe whether the break is haphazard or shows evidence of careful selection as to place.

Geographical Distribution. Having found the name of the specimen in the snailery, it may be possible to find how extensively it is distributed over the state, over the United States, or over the world. This information may be had by consulting a library with conchological literature, or by inquiry of friends versed in knowledge of shells. In any event, whether the information is found or not, suggestions may be thrown out as to ways by which the species may be scattered, reasons for dispersal, and barriers which may prevent it.

Some Devices Tending to Insure Cross-Fertilization of Plants.

Maurice Ricker.

The oak has a wind-pollinated flower. In some plants the pollen is carried by water. A large number of the conspicuous flowering plants are pollinated by insects, bees taking the leading part, though moths, butterflies, flies, beetles and bugs do much of the work. Some of the deep throated flowers, as the honey-suckle, are pollinated by the humming bird. Other especially adapted plants are said to be pollinated by snails.

Christian Konrad Sprengel was a pastor in a German parish until he neglected his duties, to the extent that he lost his position. This neglect came about through his love of the study of plants. He then made a precarious living by teaching the languages and mathematics, and continued his investigations, the results of which appeared in 1793 in a volume entitled "Das Endeckte Geheimnis der Natur." He shows in this book a perfect understanding of the nature of fertilization and believes that insects play a part in putting pollen upon the stigma. Waetcher in a memoir in 1801, taught the structure of the orchid pollen-mass, or pollinia, as it is now called, and showed that it must be removed by an insect.

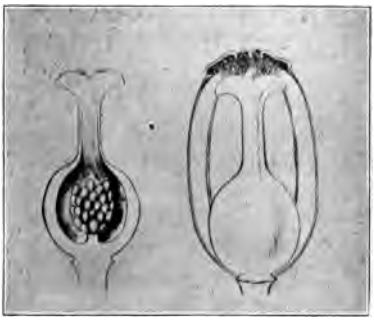


FIG. 24.

It remained for Darwin to discover the real secret of nature. He approached the subject through experimentation upon flowers fertilized by their own pollen as contrasted with those which are fertilized by the pollen of other flowers. His book on the "Fertilization of Orchids by Insects" appeared in 1862, nearly 70 years after Sprengel's work was first published in Berlin. We have illustrated the difficulties in the way of accepting Sprengel's work and Darwin's final solution of the problem by four charts, after Gibson.

The first (Fig. 24) shows how Sprengel taught the method of fertilization by showing how the pollen is shed upon the stigma by being borne above it.

The second chart (Fig. 25) shows how Sprengel overcame objections to his theory when his attention was called to flowers which bear the anthers below the stigma. It shows bees crawling over the nectaries, incidentally smearing themselves with pollen, and then climbing over the stigma, carrying the pollen with them.

The third chart (Fig. 26) shows the next problem with which Sprengel was confronted. Flowers were found where the pollen is all shed before the stigma is open or receptive to pollen. These are what we now call proterandrous flowers. Somewhat similar in nature is the problem of the proterandrous flowers where the stigma ripens before the anther. Sprengel is said to have admitted that he could not solve all these enigmas but that, nevertheless, he thought there were reasons for these various structures.

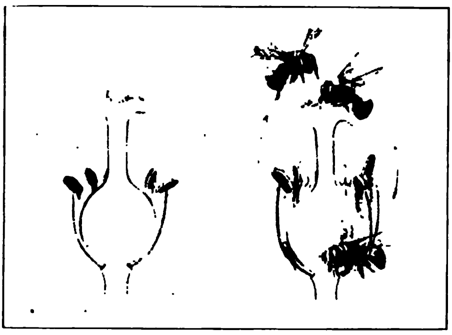


FIG. 25.

Darwin, coming at the problem from the standpoint of cross-fertilization, saw it as in chart four (Fig. 27), which represents bees going from the ripe anthers of one flower to the receptive stigmas of older flowers; and it was made clear.

In his twelve years of experimentation on the subject of "Self and Cross Fertilization in the Vegetable Kingdom," Darwin showed that not only was it advantageous for flowers to be fertilized by pollen of other flowers of the same species, but that they produced more seeds if fertilized by pollen from distant fields. These two books by Darwin are of great interest to the botanist and may be read with profit by any one. As examples of the exprimental method of to-day they are worthy of consideration. I suppose no other man has sepnt such years of painstaking labor and accompanied his theories with such an enormous amount of data.

Some plants, like the common violet, have two kinds of flowers. We only note the ones that open to insects with their beautifully colored corollas, but there are others, which may be found later in the summer on the same plant. These do not open but shed the pollen upon the stigma, in the mud, as we might say. These are called cleistogamous flowers and I believe are borne only upon those plants which also produce the ordinary showy flowers, thus insuring cross pollination at some period in their history.

Many flowers provide against self-pollination by some such common device as in the bluet (Houstonia), where some flowers bear the anthers in the lower part of the cup and the stigma near the top, while in other plants adjoining and perhaps raised from seed from the same plant, the opposite arrangement of anthers and stigmas is found. One can readily see how this will result in preventing self-pollination and furthering cross-pollination.

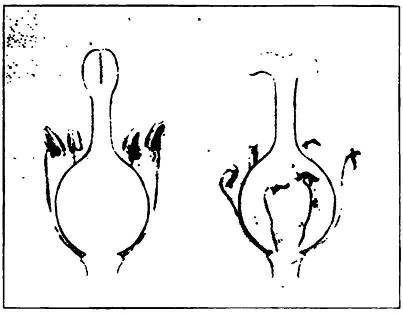


FIG 26.

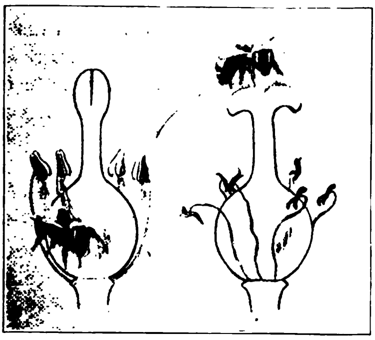


FIG. 27.

A still more effective method is found in many flowers where the parts mature at different times, as has been already mentioned. The most effective method, however, is shown in those plants like the willow where only pistillate flowers grow on the one plant and only staminate ones appear on another. These are called dioecious plants. The oak represents the type where the two kinds of flowers are borne separately on the same plant. These are called monoecious plants.

As might be supposed, those flowers which depend upon wind pollination must produce a great abundance of pollen, even though every device such as light feathered pollen be brought into use. The monoecious rag weed and the pines are good examples of plants which shed their pollen freely. We can readily see how great would be the benefit to a plant if an insect could be induced to carry its pollen. The saving in quantity would be considerable, as well as the advantage before mentioned of pollination from a distant plant.

Since there are no one sided bargains in nature the insect must be enticed and paid for his trouble. This involves the necessity of the plant's putting up some kind of a free lunch in the shape of nectar, as in the clover, or edible pollen as in the rose. In the Spiderwort we have some fine hairs growing from the stamens which must make delicious fodder for some of the bees, judging by the way they eat it. Some plants offer lodging for the night and protection from storm and cold. What more could a vagrant insect ask?

The fact that this free lunch is offered must be advertised, either by an odor to entice the hungry insect or by a showy blossom. Some plants with small inconspicuous blossoms, as in the clover, unite into heads so the busy bee can readily go from one to another without loss of his valuable time, for the summer is short.

One can follow out this idea almost indefinitely. Plants blooming at night have white flowers because they can thus be more clearly seen by their nocturnal visitors. They are also more likely to be fragrant. Flowers desiring nocturnal visitors are likely to be closed the rest of the day. Flowers that are open for business only a very short time, as the morning glory, have not only showy flowers but delicate stripes of color running from all sides down to the nectaries, seemingly to direct the insect to the sweets with as little loss of time as possible. These nectary guides, as they are called, are very conspicuous in many insect fertilized flowers. By following these guides, the welcome host will always rub against the essential organs of the flower and thereby assist in pollination, or in other ways pay for his sup of nectar.

It may be interesting here to note that the early botanists thought nectar was a waste product that must be removed, and an early suggested reason for insect visits was to assist the flower in its removal.

While most insect-fertilized flowers are beautifully colored and many of them pleasantly scented there are also some that are flesh-colored. They have a bad odor, as the smell of decaying meat. The visits of carrion flies suggest the purpose of the bad odor.

Sir John Lubbock made an interesting series of experiments from which he deduced the facts that dull yellow, brownish or purple flowers seem to attract flies more especially. Also that bees and butterflies are more likely to go to violet, red or blue flowers. Packard believes that no insect can distinguish clearly color or objects at a greater distance than six feet. What extremely short sighted animals they are! We know that odors will attract flies from much greater distance.

The insects, as well as the flowers, are modified to meet the conditions that arise from this inter-dependence. When Darwin's book was under discussion soon after its first appearance, some one brought a flower from Madagascar which had a nectary measuring seventeen inches. Some were inclined to ridicule Darwin's theory and ask him to produce the insect having a tongue long enough to reach the sweets at the bottom. Though no such an insect was known, Darwin readily accepted the challenge and declared that he would stake his theory on the proposition that somewhere there was an animal capable of reaching it, else there would have been no such development. His critics were much disconcerted soon afterwards by the finding of just such a moth as Darwin had said there must be.

Let us consider some of the devices for preventing waste of pollen in insect fertilized flowers. We can readily see that after a plant has specialized to such an extent as to secure transfer of its pollen by certain flying insects only, that it may be necessary to arrange some means to keep out a large class of crawling insects, like the ants, which might seek to take advantage of the food and at the same time be of no use to the flower. They would not be adapted to transfer pollen to another plant in good order. The nasturtium for instance has numerous bristling hairs that bar the way to the nectary. The snow-berry has a perfect ball of cotton over its sweets. Some plants as the sunflower have such spiny, hairy stems as to discourage creeping visitors. Other plants secrete sticky gums which act very much in the same way as hairs, in that they are a serious impediment to insect travel. Some plants, like the milkweed, have smooth, waxy stems which are easily punctured by the sharp claws of a climbing insect. When the plant is injured the sticky milk will flow out and one can readily understand how disgusted an ant would soon become with such a plant. The rubber plant has sticky sap for the similar purpose of self protection.

Numerous schemes for prevention of visits by any other than the favored guest might be cited. The nectary is often located in long spurs where only long tongued insects can reach it. The columbine has five such spurs. The common flies and bees cannot disturb this flower. It reserves its nectar for certain long tongued insects. The bumble bee sometimes thwarts nature's scheme by alighting on the outside of the flower, and cutting a hole for a back door, as it were, drains the nectaries dry without having touched the essential parts of the flower. If this ingenious device of the bumble bee should become universal among bees it might have a serious effect upon the plant's survival. It would then have to depend upon allies of the butterfly order, who carry no knives, to make the first call.

One of the most astonishing tricks in the plant world is played by the blue flag or iris. One must examine a flower and find the parts to fully appreciate the situation (Fig. 29.) At last you will find the false honey guides running down the interior of the flower and Needham reports that many insects seem to make the very natural mistake of probing down the center of the flower as indicated by the guides, for the nectar. They find nothing and go away no doubt with a poor opinion of the flag.

A bumble bee, for whom the flower seems especially designed, alights

FIG. 28.

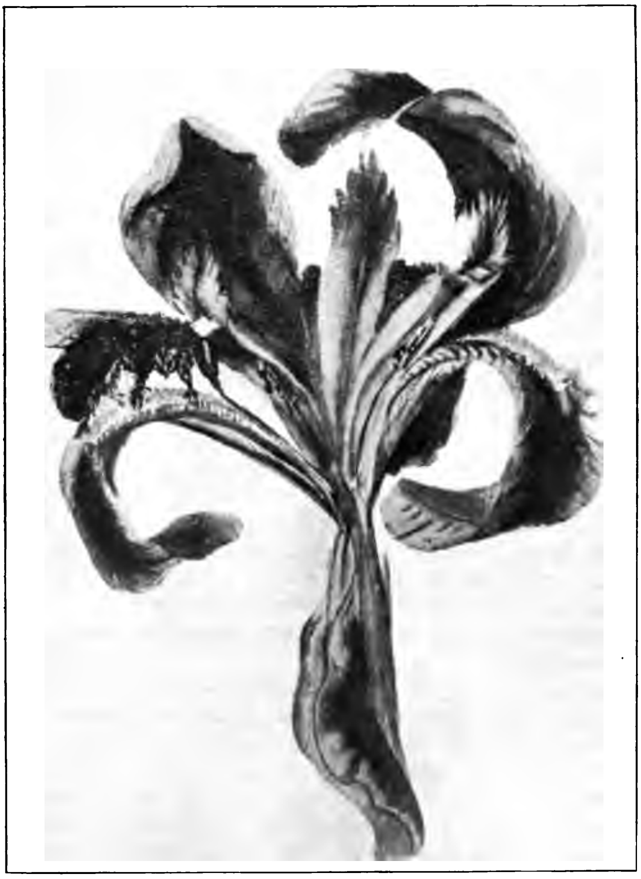


FIG. 29. The blue flag. From water color drawing by Mrs. Edith Ricker.

upon one of the graceful sepals and his weight is just sufficient to separate it from the closely covering carpel. The bumble bee then wedges himself in between the slowly opening part and, by stretching his long tongue to its full length draws the nectar from its deep well. The true honey guides are on the upper surface of the petal. The cover is a style and bears the stigma on a shelf like projection just where the bee will rub his head and thorax in wedging himself in. The stamen rises and bears an anther at the point where it wil rub the pollen into the thoracic hairs of the bee. Why is not this same pollen left on the stigma when the bee backs out? If the stigma shelf is rubbed with the finger it opens outward as by a bee in entering, and closes when rubbed the opposite way. Thus the pollen gathered from this flower will be transferred to some other flower. The blue flag teaches us several lessons in adaptation. All of the irregular flowers are peculiarly shaped with reference to their insect visitors. They are a source of never ending speculation.

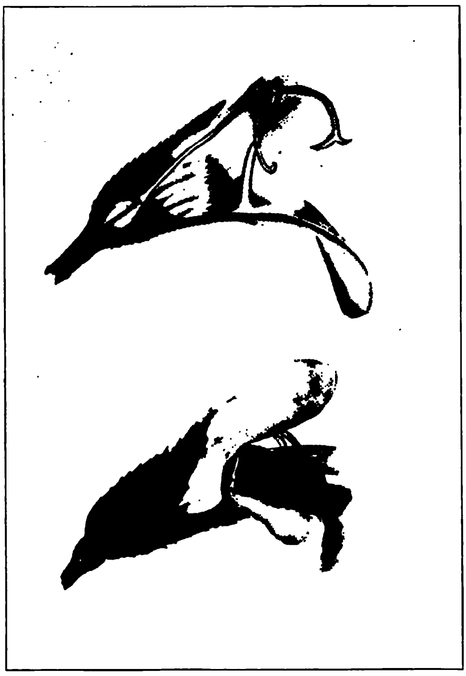


FIG. 30.

Protective closure to keep out rain and unwelcome insects has been mentioned earlier. The hanging position of many flowers serves the same purpose. Many flowers have a movement of parts in addition to this closing, some of which are of great interest. My attention was first called to a closing of the lips of the stigma in the catalpa. Near the station, at Big Fork, is a swampy place where many interesting plants abound. On inspecting a number of blossoms of Mimmulius (Sp—) (Fig. 28) I found the styles different in various plants of all ages and proceeded to tickle them with a straw. The style divides into two flat surfaces at the end which spread widely apart, as is so often the case. Selecting one that was well open. I found on touching it that it closed slowly and in perhaps thirty seconds was shut up as tightly as if it had never been opened. After a few minutes I visited the plant again and found it was slowly opening. The plants taken to the laboratory for experiment did not stand the trip very well, and reacted somewhat more slowly than in the field. When fertilized with fresh pollen from another flower the style will remain permanently closed.

We now come to one of the most interesting arrangements in the botanical world illustrating plant movement to bring about cross pollination. The sage was figured in Darwin's earliest work of this kind and given to the world as a wonderful piece of floral mechanism.

The sage flower is irregular, having one of the petals produced into a landing place for flying insects (Fig. 30.) The anthers are modified with a peculiar arrangement which can be better understood from the figure or the section of the flower. Two standards carry each a sort of C shaped piece, which is delicately poised so as to stand in a nearly vertical position, if the flower is held horizontally . A bee in order to enter the flower must go between these standards and in so doing will necessarily push the lower part with his head and rock the anther bearing part over so as to dust his back with the powdery pollen. Since the sage is proterandrous, the stigma will be non-receptive even if it were far enough out to receive the pollen. If the next sage visited has a ripened stigma the style bearing it will have grown long enough and will curve down so that it must rub the back which was lately dusted with pollen. The bee will receive no pollen from such a blossom as its pollen has all been scattered. The sage has indeed a wonderful story to tell to those who will stop to consider it.

Certain flowers greet the entering insect with a bombardment of pollen. This is produced in various ways and does not seem to be anything of a surprise to the visitor who proceeds to collect his fee for carrying his load of pollen to the next flower.

Our common Milkweeds have a waxy pollen mass and will need investigation. They have been charged with the murder of hundreds of innocent guests and any summer day one may find them holding their dead victims fast by the legs. The insect finds himself caught and is perhaps, unable to pull his legs out of the trap or pull the trap with him. This trap, which consists of two bags of pollen, he is supposed to take with him. An insect's foot, coming into contact with the V shaped slit in the trap formed by the union of the two pollen bags, is quite likely to be caught. If the pollen be ripe, and normal in every way, any ordinarily strong insect is able to pull the pollen sacks free from the flower if he does not get too many feet caught at the same time. If he has a foot firmly fastened in one flower and in trying to pull out tangles another foot or two, he may tire himself out and die after a hard struggle. Insects usually succeed in pulling out the pollen sacks. These they carry to another flower, and drag over the stigma with the desired effect.

The orchid represents the most highly specialized flower and a consideration of these wonderful forms must be left until another time.

The Plant Associations.

Harry Nichols Whitford.

From what has been said in the preceding pages it can readily be seen that the climate affects the distribution of plants. The so-called **plant formations** are the direct result of certain climates. However, the landscape of **a forest formation** (Fig. 5) does not show an equal distribution of the kinds of trees in it; nor does it show an unbroken mass of trees. On the other hand there is a tendency for trees of certain kinds to be growing together, and there are gaps in the forest, island-like openings, as it were, in the sea of trees. The gaps may contain a meadow, a heath, or even a prairie. A **prairie formation** may also contain trees in certain favorable situations (Fig. 5) where there is a sufficient water supply. In distinction from the **formation** these groups have been called **plant associations or plant societies.** It is now in order to inquire what causes have brought about the division of **formation** into **associations.** This can be done best by selecting a limited region in the forest formation, for example, and by noting what associations are found and in what conditions they are growing. The region around the Montana Biological Station at Big Fork is a good one to illustrate the point. Any region in the state can be studied in the same way, whether it be in the prairie or forest.

In the **forest formation** near Big Fork there are five more or less distinct **plant associations.** In the low places in the Swan river valley along streams and around ponds are moist areas that are usually submerged during the spring and early summer months. These are known as **meadow associations** (Plate LII.) The grass type prevails in these places, grasses and sedges of various sorts being here associated. Oftentimes peat moss is abundant, and with it may be found the interesting carnivorous plant called sundew. Around the borders of the meadows, and sometimes in them, are willows, alders and birches. Shallow ponds containing water lilies and pond weeds are often found in the meadows. It is very evident that the reason why trees do not grow in these meadows is because there is too much water, which, like too little water, is injurious to them.

Bordering on the meadows are localities, not quite so damp, where the Engelmann spruce and other plants growing with it are found, forming what may be called the **Engelmann spruce association.** On the edge of the meadow the trees of this association are small and scattered. Depending on the amount of water in the soil, there may be peninsulas and islands of spruce in the meadow. Sometimes there are almost pure stands of spruce forests; again the spruce element is scattered along streams. Very often lodgepole pine, narrow-leaved cottonwood, aspen, and birch are associated with the spruce. These particular combinations of trees are always found in soil that is quite damp, but not so damp as the soils in which the meadows occur. It must not be supposed from what has been said that the trees mentioned above never grow in other situations, for they do, as will be seen later. In the spruce associations they are the predominant trees. In some of the other situations, they are subordinate.

Around the drier borders of the spruce association, and sometimes on peninsulas or islands in it, are stands of trees other than those mentioned. These trees are clearly associated with soil in which the water level is still further beneath the surface. Because the western larch and the Douglas spruce are the most common trees in this stand, it will be given the name of **western larch—Douglas spruce association.** Far the greater part of Swan valley is occupied by this association. Other trees in it are the lodgepole pine, lowland fir, silver pine, and occasionally an arbor-vitae. The Engelmann spruce and the birch are sometimes present also, though they seldom form a conspicuous element. The lodgepole pine (Plate LII) occupies vast tracts of this area. Its presence here is clearly due to fires. Often the older trees of western larch and Douglas spruce, their charred trunks telling the story of former fires, are seen standing above young forests of lodgepole pine. Sometimes almost consumed trunks show that the fires have been more destructive. The western larch and the Douglas spruce are the last to be killed by fires, because they can resist them best. Where fires have not been so destructive, the lodgepole pine is less conspicuous. Indeed, in places it is almost entirely wanting. The lowland fir, silver pine, and Engelmann spruce are more abundant in the moister parts of the western larch-Douglas spruce association. In isolated patches the bull pine is also found.

Just as the meadows form treeless places in the forest formation so occasionally the **soil** may be too dry to form forests. It is a well known fact that clay soil holds water better than sandy soil. The rainfall may be sufficient to support trees in the former, where it would not do so in the latter. This fact may account for the prairie "islands" in the **forest formation,** to be seen in Fig. 5.

Surrounding these prairie islands and bordering on the **prairie formation** is another type of forests which is due primarily to the fact that there is more water in the soil than in the prairie, and less than in the western larch-Douglas spruce association. This type of forest may be called the **bull pine-Douglas spruce association,** because these two trees are the predominating ones. Sometimes the western larch is found with these, but it never occupies the drier soils. In other places the Rocky mountain juniper is present. The bull pine-Douglas spruce forest usually is an open one, with grass patches between the trees. It grades imperceptibly into the prairie formation.

In the foregoing it is shown that the type of plant associations in the forest formation depends on the amount of water in the soil. Warming, a Danish botanist, who was the first to fully perceive this relation between the grouping of plants and the amount of water in the soil, classified plants into **hydrophytes, mesophytes,** and **xerophytes.** Those plants that grow in soils with a great amount of water in it are known as **hydro-**

phytes. This word comes from hydor, meaning water, and phyton, meaning plant. Those plants growing in soils with an intermediate amount of water are known as **mesophytes**, that is, literally intermediate plants. Those plants growing in soils that have little water, are known as **xerophytes**, that is, dry plants. Now it is convenient to use the terms **xeromesophytes** and **hydromesophytes**. So under this classification the associations discussed above are as follows:

A wet meadow is a hydrophytic association.
An Engelmann spruce forest is a hydromesophytic association.
A Western larch-Douglas spruce forest is a mesophyitc association.
A Bull pine-Douglas spruce forest is a xeromesophytic association.
A prairie is a xerophytic association.

In the **prairie formation** there are two places where trees may grow, namely, along streams and on protected hill sides. It is obvious that in the former situations the roots of the trees penetrate to or near to the underground water level, which is not far from the surface. In the latter situation (Plate LII) the fact that trees are protected from drying winds and the soil from the heat of the sun, prevents both trees and soil from drying out rapidly. The plants that grow there can get more water and give off less than they would absorb and transpire if the hill were not present. Thus the protected slope of a hill may have forests in a **prairie formation.**

Again, if a hill be high enough to cool sufficiently the moisture-bearing winds so as to cause precipitation of moisture, it may get more rainfall than the lower lying land. This is very probably the reason why the tops of mountains or of high hills in prairie regions have trees and sometimes dense forests. This leads to the dicussion of the forest conditions in high mountains.

The climate towards the top of a mountain is different from that at its base. It is always colder and usually more moist. The moisture conditions are favorable to trees, the low temperature conditions are against tree growth. The slopes exposed to dry winds have less moisture for trees than those not so exposed. At the same time the exposed slopes receive more heat, rapidly melting the snow, which would otherwise lie longer, and thus shorten the season. As a consequence tree growth is more prevalent on these slopes than on the protected slopes where the snow lies the year round. As one ascends a mountain like MacDougal's peak or Hall's peak, which are in the Swan range bordering the Flathead valley on the east, the species that require the most heat will disappear first. Those that are adapted to a shorter season will be found higher up. The bull pine is one of the first to disappear. Higher up the western larch and silver pine are absent, and on the ridges the Douglas spruce and lodgepole pine are the last of the lowland forms to disappear. In the valleys the Engelmann spruce will be found as high as these or higher. Before the conditions are too severe for the last three named species, the alpine trees come in. In the region under discussion these are the white-bark pine and the alpine fir. (Plate XLVII.) It has already been shown that the latter species is found occasionally in the valley. In the cold canyons it and the Engelmann spruce may form almost pure forests. Near the top of the two mountains under discussion, the exposed places have only the two alpine trees, the white-bark pine and the alpine fir. In basins on the east side, however, the conditions are different. Here the snow lies longer. The white-bark pine is infrequent here, but the alpine fir does better than on the exposed ridges. In the basins there are three distinct plant associations. On the steep slopes where the weathering processes are frequently adding new rock material, (Plate XLVII) the conditions are too strenuous for the existence of any plants. As soon as one of these talus slopes becomes stable enough, then plants begin to get a foothold, and finally trees may appear. In places where the snow lies the year around, there is no vegetable life except the simple one-celled plant known as the "red snow." Bordering on these snow banks are the so-called alpine meadows. (Fig. 31.) They usually follow up the retreating snow and sometimes dog tooth violets, spring beauties, and anemones come up through the snow itself. Thus one can see these forms just appearing on the border of the snow field. At a little distance they are in full bloom, further away where the snow has disappeared earlier they have produced seeds, and still further from the snow they have finished their growth and have died down to the ground. It is usually in the latter places that one finds groups of trees, (Plate XLVII) nearly all alpine fir, for they appear where the snow first melts. Thus there is a relation between the plant societies found in these regions, and the time snow lies on the ground.

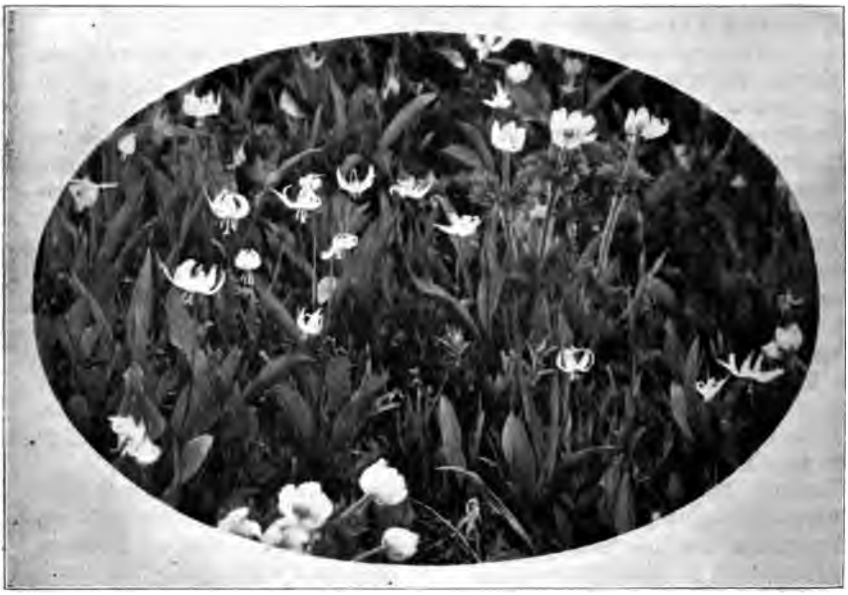
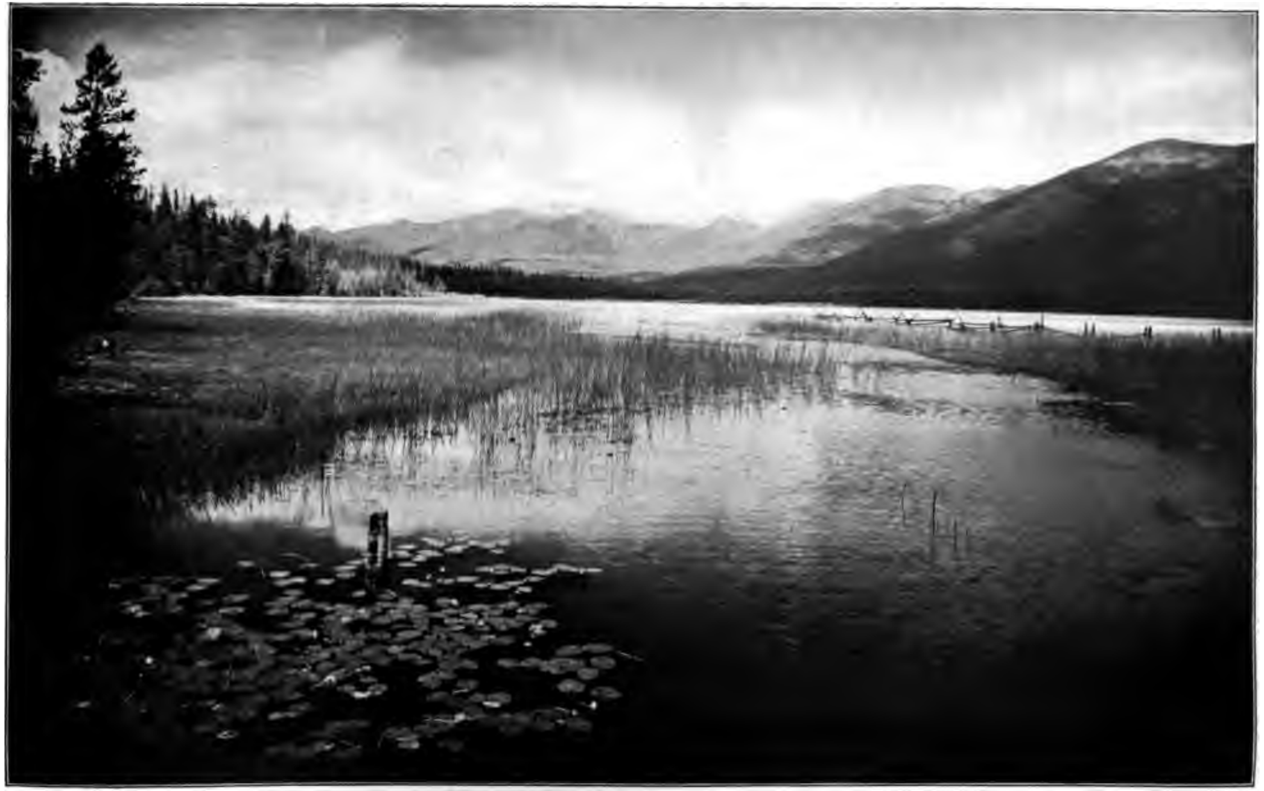


Fig 31. Portion of an alpine meadow, 7000 ft. altitude, Swan range, August, 1903. Photo. by M. J. E.



General view of Rost Lake from the outlet. The Swan Range of the Kootenais is in the distance. Around the lake are tree or forest plant association. Bordering these are meadow societies. In the water are hydrophytic forms.

Bird Music in the Flathead Region.

Perley Milton Silloway.

Bird music is the blossom or flower of bird life. The plant is with us throughout the summer and perhaps throughout the year, but its fragrant flower attracts our attention during only a limited period of its summer life. So it is with the bird song; it reveals a life that may have been neglected until that time, and for a brief period we wait and listen for the bird. A little later the song dies away, and the author is likely to be overlooked during its further existence among us.

The bird song is an index of a changing phase of the bird's activities. Its hundrum habits of the workday world are to be laid aside for a time, and it is to enter upon a brighter and more joyous period of its yearly round. New impulses actuate its little breast, and its kindling spirit leaps forth in song. For weeks and months it has been silent, except in such calls and cries as have been impelled by its usual emotions, but as it sees its little world enlarging to renewed companionship and more enjoyable relationships, it gives unusual utterance to impulses newly aroused, and the song becomes a part of its daily experience.

As is well-known, the gift of song is generally confined to the male bird. Though the rule is not invariable, the exceptions are few enough to prove the rule. The fact that the male bird alone produces the real song has led to the conclusion that the song is a means by which the male announces his presence to his lady-love, and by which he seeks to attract her attention to his graces and accomplishments. Bird music is the forerunner and accompaniment of the mating season, and continues through what may correspond to the "honeymoon" of more rational beings. The song is prompted by the sexual instinct, and in the mating season is doubtless designed to please some listening female. Once her attention is attracted and her ear captivated, the song becomes one of the ways in which she is wooed and won. After she has been won, the song becomes an index of the domestic bliss of the songster. With many birds, the season of song ends quite abruptly with the beginning of the female's household duties; with a few, the period of song is prolonged even until the younglings have left the nest and are able to forage for themselves. In some instances, there is what appears to be a fall period of song, though the fall singing of any bird seldom equals its vernal performances in power and volume.

Some of the birds come to us on their way northward in the spring, caroling in the renewal of their domestic felicity. During the weeks of winter we have missed the presence of the songsters, but on some auspicious morning we hear the old familiar carol, and we note that one of our avian friends of last summer has returned to us. So our bluebird comes to us, and sitting in the top of a convenient tree or on the ridge of some low building, it warbles its tender message of the returning spring. For several weeks after the advent of the bluebird, the lowvoiced utterances of this species charm our ears. Then the songs cease in frequency and spirit, even before the sitting bird has seen her younglings break the delicate blue-tinged shells. When we arrive at the Biological Station for our annual summer outing, the voice of the bluebird has been hushed, so far as its song is concerned; its tender calls, however, can be heard as we chance on the birds flitting from the deadened boles of the adjacent ridges. To some of us, at least, these calls are a plaintive reminder of the earlier song season, and are worthy of a place in our thougths regarding the bird music of the region.

Of our familiar western robin, what shall we say that has not often been said? In his usual business-like way, he comes from his southern sojourn, squeaks about the neighborhood for a day or two until he gets his bearings and ascertains that everything is as it was when he departed late in the preceding autumn. Then he begins his recitals, generally from the topmost branch of the tallest tree in view, giving his lyric as a fitting ending to a day that has begotten in us a genuine case of "spring fever." There are but few feet in a verse of robin music, and that verse is oft repeated. Florence Merriam has quite accurately described the song in syllables "trill-er-ee, trill-er-ah." Generally the song is enunciated in a loud, hurried manner, so nervously that it appears as if the songster were losing breath; at times, however, the song is uttered in a high, squeaky falsetto tone, the same performer sometimes changing from one tone to another at will. Again, the singing is done in a low, subdued tone, for our friend robin frequently drops into a poetic mood, especially if his fair charmer is sitting near, and often whispers his flatteries into the ears of his promised bride. The song season of the robin is longer than that of the bluebird, and in this region is prolonged by some individuals well into July, the late songs, however, being heard chiefly early in the morning and less frequently late in the day.

As we skirt the shores of Daphnia Pond (See Plate XLIX) in quest of biological specimens, the singing of the catbird greets us like the strains of familiar music. Nowhere in this region is this gifted songster more numerous than on the enchanted shores of Daphnia Pond. In the bushes there the catbird nests until late in August, and as it thus prolongs its domestic duties, it carries the spirit of song far beyond the season common to most of our bird musicians. Sitting in some secluded nook of the bushes, this songster gives expression to its impulses in voice low and sweet, in most fitting accord to the fast ebbing tide of summer bird music. The opening hours of the day are generally used by the catbird in its recitals of the later season. At such times we must rise early in the morning if we want to hear the birds begin to sing. In the cool morning hour the catbird is at its best, and if a nest is anywhere in the neighborhood, the listener is certain to be regaled by a prodigality of wildwood music by the gifted owner of the household.

The warblers, notwithstanding their name as a group, do not excel generally in musical powers. Many of them, though, are songsters of no mean ability. The vocal power of the warblers that occur in the Flathead region serve about the same function in the woodland chorus as the side-horns in the instrumentation of a large band. They are not soloists nor leaders, but they furnish the harmony in accord and accompaniment, and thus aid in bringing about an effect which is quite satisfying to the listener. So it is with the efforts of that gem of the swamp-woods, the American redstart. Its song is short, ringing verse, very similar to that of the yellow warbler, and is repeated from time to time with great energy and earnestness. Like the catbird, the redstart nests comparatively late, and hence its singing is an incident of our life at the Station during these summer sessions, in the early part of July.

Any of us who has been so fortunate (or unfortunate) as to have been delayed at Selish, may have heard the peculiar notes of the long-tailed chat in the bushy tract near the depot. The chat itself is one of our beauties, a yellow songster somewhat smaller than the catbird. No other bird, unless it is one of the smaller sparrows, understands so well and practices so much the art of skulking. When you are looking for the chat it is certain to be behind a convenient tangle of branches or foliage. Its music, though, will continually come to your ears, not in song, but in a series of strange whistles, suggestive of schoolboy signals, and uttered in varying intonation. It is to be hoped that the chat will work its way northward and establish itself among the bushes of our classic Daphnia.

(In 1903 the chat appeared in the bushes of Daphnia and its song was heard daily.)

Another warbler whose song can not be overlooked is the western yellow-throat. This handsome songster skulks in the reedy tangles of Daphnia Pond, and there its energetic singing regales us who have an ear open to the voices of the birds. The song of the yellow-throat is an accompaniment of the July afternoons, for this warbler has a note till the end of the nesting season. The usual production may be represented by the syllables "wich-i-ty, wich-i-ty, wich-i-ty," generally in series of three, with the emphasis on the leading syllable. It is a loud, ringing song, uttered with persistence throughout all hours of the day, and always from some low situation. The songster is a handsome little yellow creature, easily identified by the band of black which marks his upper face and forehead. His less musical spouse lacks the black markings, and is not so readily distinguished from other small yellow birds, but she may be known by the rich yellow of her throat on the under side.

The two representatives of the vireos fill no mean place in the avian chorus of this region. Both are persistent songsters, and through all the summer their voices can be heard mingling with other wildwood performers. The warbling vireo utters a series of hurried, subdued measures, characteristized by a plaintive intonation, forming a most pleasing song in gentle accord with its surroundings. The song of the red-eyed vireo is a loud, monitorial repetition of three or four syllables, easily identified by its peculiar delivery. This songster has been called the "preacher" because of its monitorial style of execution in its singing. Wilson Flagg has aptly translated the song of the 'preacher" in these words: "You see it—you know it—do you hear me,—do you believe it?"

The vireos are unlike most of the birds in the manner of their singing, as they prefer the shade of the foliage of the deciduous trees they haunt, and do not choose a perch out in the bright sunshine from which to render their measure. Again, they do not sit and sing simply for the sake of singing, like many of our songsters; their singing is incidental, uttered as they appear to be busy in gleaning their daily bread from the foliage of the trees. The female of the warbling vireo is equally gifted with song-powers with her mate, and she has a pretty habit of singing in response to her spouse while she is sitting on her nest.

In respect to song, the cedar waxwing is one of the most peculiar birds we have, for it has no real song. The only utterance of which the waxwing is capable is a soft lisping call. Even in the mating and nesting time the waxwing can voice its emotions only in these feeble lispings, which are scarcely forcible enough to be described by our idea of the word chirp.

A voice of considerable importance in the bird music of this region is that of the Louisiana tanager. This songster frequents the coniferous trees of larger size, where its bright yellow attire, ornamented with black wings and crimson head, seems in strange contrast to the dark evergreen of its environment. The song of the tanager is much like that of the robin, so much like it in fact that the listener must discriminate very closely to distinguish the difference. The tanager's singing is more nervous, and more sharply uttered, lacking the full treble of the robin's performance. This splendid gem of the coniferous woodlands is not sparing of its music, and continues in song well into July. Its frequent recitals serve to apprise us of its presence near the Station; even from the Station door we may hear its characteristic song from the tall conifers that line the river's bank.

Another songster of late summer is the lazuli bunting. It frequents the roadsides, singing a-perch of telephone wire or in the top of some tall tree. Its song is a pleasing little ditty, uttered with great persistency and considerable spirit, though with little variation. The performer may be known by his coat of indigo blue, his orange-tinted breast, and light underparts. He is a little fellow, scarcely larger than our chipping sparrow. His continued ditty is probably prompted by a cozy cot of dried grass in the bushes below or in the near neighborhood, in which his more demurely attired spouse is nestling her pale light-blue eggs.

The black-headed grosbeak contributes a generous share toward the bird music of this region This songster has a rich, full voice, and its song is somewhat like that of the robin or that of the oriole, what might result by a medley of the songs of the two lyrists mentioned. The grosbeak frequents the deciduous trees, perferably the dwarf trees in low situations, in company with the vireos, redstart, and cedar waxwing. It is also a songster of late spring and early summer, and consequently we hear its mellow music in the early part of July. Like some others we have mentioned, the black-headed grosbeak is well at home on the shores of Daphnia pond, where it rears its brood in the low trees. The male is a model husband, for he is noted for his care of the household. He it is who sits at home brooding the eggs, while his spouse visits about the neighborhood with other grosbeak dames. When the youngsters are ready to leave the parental roof, it is the male who usually takes them in charge and instructs them in the way of making an honest grosbeak living.

Another songster of the bushes is the arctic towhee. It prefers the shrubbery in the neighborhood of ponds and streams and lakes. Its song is not a masterpiece of musical power, but it has a place in the wildwood orchestra, and would certainly be missed by anyone who has learned to know it. The usual call of the towhee is a group of about two syllables, which has suggested its name, for it resembles the word "towhee." The singing of the towhee consists of short series of notes suggesting the words "Ain't I pretty?" repeated with monotonous persistence from some low situation. The ending of the performance is a rattling trill, uttered with rising inflection and slurred in its hurried execution. The song is very easily identified by close attention on the listener's part.

The mountain song sparrow is one of our masters of song. It is a hardy little creature, being among the earliest to arrive from the south in the spring, and one of the first to open the vernal season of song. By the time our Station work begins, the high tide of sparrow music has spent its force, and all that remains for us is the slowly subsiding ebb. Our song sparrow, though, is one of the few songsters that can utter its cheerful roundelay at almost any season. The males are generally in song until they take their departure in the fall, and at any time one of them is likely to give a gentle, tuneful recital.

The song sparrow is famed for its varied repertoire in musical performance. The singing of any particular songster is much the same to ordinary listeners, but with no great degree of discrimination it can be perceived that a number of different songs make up a day's program of this little virtuoso. The same song may be given an indefinite number of times, when the songster will vary the arrangement so strikingly that the result will be a different song, which is repeated at impulse. Thus from time to time each song sparrow shows himself to be a master of eight to ten songs, each so unlike the others that it will pass for a different song. Generally the song begins with several distinct notes of equal value and tone; then there follows a series of hurried, blending syllables, ending with a cadenza of tuneful spirit.

In our account of the bird music of this region, we must not forget our junco, not because of its leadership in song, but because its music is a part of the later springtime which we enjoy in the early days of our Station season. Furthermore, the singing of the junco is so similar to that of the familiar chipping sparrow, that it is worth while to mention it that we may give the former its due share of credit for the rattling trills that we hear so frequently in the woods. The song of the junco is louder and sharper than that of the chipping sparrow, though like that of the latter, it is a series of monotonous chirps. It is usually uttered from one of the taller trees, preferably one apart in the sunshine or in the margin of the woodland.

In most portions of the Flathead region the singing of the western vesper sparrow is a noticeable feature. You remember it is the song of this sparrow about which John Burroughs wrote so charmingly. Someone has described the performance of the vesper sparrow as that of the song sparrow reversed, for it begins with the candenza, and ends with the two, three, or four accented notes. At the southern end of Flathead lake the western vesper sparrow is prominently abundant, and if it should chance to be your fate, as it once was mine, to spend a Saturday and Sunday at Polson waiting for the steamer, you will have ample opportunity to become acquainted with the musical powers of this gifted songster.

What limit shall we place to our definition of bird music? As we sit in the Station grounds, we hear overhead and about us the sibilant calls of the pine siskins, as they sport from treetop to tree in their social movements. It is music to the ears of the bird lover, at least, if it will not pass muster among the classic performances of the thrushes, tanagers, and grosbeaks. The pine siskin has no song, but its calls fill a large place in the avian chorus hereabout. One of its calls is a plaintiff "pee pee," the same as that uttered by the goldfinch as it swings in its billowy flight in the sunshine of late summer.

When we brave the tangle of the thick arbor-vitae swamps that crowd some portions of the banks of our splashing streams, we may hear the singing of the winter wren. Indeed, we may hear it on the banks of the Swan river, within fifty yards of the south end of the bridge near us. It is a peculiar song, but it is real music, a gush of hurried, spirited semi-demi-quavers, every note of which is emphasized by a movement of the tail of the nervous little performer. On the rocky ridges of the "Big Burn" east of the Station, the western house wren sings its roundelays, with which you are doubtless rather familiar. In the swamps at the head of Swan lake, we have the tule wren, the western representative of the long-billed marsh wren. The singing of the three foregoing species has a dcided generic resemblance, but the performance of each is characteristic and worthy of special note in an extended study of Flathead bird music.

There are many voices which enter into the composite product of bird music of this region, that can not have even a passing mention in a paper of this length. One of our most common songsters, the olive-backed thrush, has not been noticed because of our inability to describe its singing in any adequate terms. It is not a fine song, and is in no wise worthy of comparison with that of its eastern relative the wood thrush, but during our sojourn at the Station we hear it in numbers, and should cultivate an ear for it. In the latter summer the evening grosbeak calls with its loud chick-like chirp as it passes among the treetops in its daily activities. Among the evergreens of the rock ledges we can identify the grasshopper-like chirps of the kinglets, and in the lower woods the long-tailed chickadee has an occasional word to say. Nuthatch and creeper visit the Station grounds and announce their persence by their feeble calls. The swallows twitter a-wing near our boarding-house. Our enumeration of the bird-voices must close. Let us remember the words of the Great Teacher "He that hath an ear, let him hear," and though our present application of the saying may somewhat pervert its meaning, let us cultivate the faculty of hearing Nature's voice through the calls and songs of the children of the air.

Plankton Studies and Their Utility.

Maurice Ricker.

This production is intended to give the students at the Station an insight into the work the University is attempting to do on the plant and animal life of the lakes, streams and ponds in this part of the state. Still better would be a few days spent in the field and laboratory with the workers.

I may say in passing that none of the activities of the Station workers appear quite so mysterious to the uninitiated as does the plankton collecting. People expect to find an occasional crank pursuing butterflies with a net. The gathering of bird-skins and even nests and eggs by the enthusiastic collector can be accounted for, because they have seen such things displayed in museums. The same might be said of the work of the botanists, for people have been accustomed to herb-gatherers and their pressed flowers since time began. The geologist, with his interest in all kinds of rocks, is regarded always as a prospector. But what shall they think of the men who labor for hours, often in the darkness of night, and even in storms; rowing a boat for miles over rough seas, or wading dangerous swamps, just to pump water through a little silk net, the contents of which the collector carefully empties into a small bottle. They watch him put in a carefully measured preservative and chuckle over his catch of objects which are all but invisible. Thereafter the term "bug-house people" takes on a new significance.

Could they know the months of labor spent in studying these forms, dissecting out and drawing parts too small to be seen except under the compound microscope; the poring over drawings, and the tedious translation of works in other language ;then they surely would be convinced that the student was the victim of no trifling mental aberration.

At a risk of becoming tedious and commonplace, I must begin by recalling a few facts well known to many of you. July 1, 1738, Charles Darwin opened a note-book for the purpose of recording facts bearing on the transmutation of species. Fifteen months later he happened to read, for amusement "Malthus on Population."

In February, 1858, Wallace lay in a chill, and while thinking over the positive checks, disease, war, famine, and so forth; as discussed in the essays of Malthus, he conceived the idea that those who survive these checks to population must be the stronger ones. In two days it was on its way around the world in a letter to Darwin. Darwin had written 240 pages on the same theory some fourteen years previously, but the essay had never been published.

I need not tell you how this doctrine has revolutionized the thought of the century, and what an impetus it gave to the most minute study of every living plant and animal. Every creature became a big interrogation point. The question was no longer, how does it look, so that we may classify it and place it in its pigeon-hole and give it a long name. The plant or animal became a much more interesting problem. Men began to look beneath the exterior appearances, to speculate as to the cause of its existence, and to trace its relationship with the plants and animals about it. Every plant or animal, however insignificant, became a link in a series of ever branching chains.

Let us recall the story of the man who began to study yeast plants some years ago. He took up that interesting old problem of how life began—whether it arose spontaneously, or whether like begets like. So he worked for years over his glass tubes, with and without stoppers, with long, finely-drawn-out, bent necks, or with no necks at all, their contents variously treated.

Had skeptical friends remonstrated with him for wasting his life over such trifles that taxed the highest powers of his microscope—and no doubt they did—I can fancy his reply, insisting that they go on with their important matters of life. There were balls to be attended, politics to be discussed, goods to be bought and sold, fashions to be studied. Paris is such a busy place. And so they took up the weighty things of life, while Pasteur laid the foundation for the science of bacteriology. This science in twenty years has robbed the rusty nail of its terror, shown the way towards the ultimate solution of the problems of diagnosis and possibly the cure of all diseases caused by micro-organisms. To-day Pasteur's picture hangs in nearly every hospital and physician's office in the world.

We could supply an abundance of illustrations showing how men in following pure science have laid the foundations for future great works. Seldom does a man take such a prominent position as discoverer and yet live to put his investigations to some practical use. Read of the work of Young and Fresnel a hundred years ago, on light. They were unread then. Franklin and the ladies and gentlemen of the French court toyed with electricity a hundred years before it was practically in use. Oersted demonstrated electro-magnetic action, and yet failed to produce a motor. Davy separated metals nearly a hundred years before their practical use. These men builded for the future, and we enjoy the heritage they left us.

There is a three-fold reason for the immediate study of the microscopic life of these waters.

Firstly—There remains much to be worked out relative to the place and importance in nature of these animals and plants; and the knowledge of them is essential in order that the sum of human knowledge regarding the inhabitants of the earth may be complete.

Secondly—These plants and animals have a wonderful economic importance little guessed by the layman. This will be brought out later under the subjects: (1) food for the higher forms, and (2) their work as scavengers.

Thirdly—The work must be done at once, before man shall have cut down the forests, clogged the waters with saw-dust and much worse sewage. In fact before man shall have so changed the face of nature that a scientist seeking for some primitive conditions where life can be studied in its natural balance, would seek in vain.

If I am able to make but one point to-day let it be that this Station offers the rarest opportunity for this kind of investigation. This region should be studied in such a way that the work done will be valuable reference when compared with changed conditions which are sure to come later.

All water life is divided into two great classes by no hard and fast lines. These are littoral and pelagic. The former has to do with life on or near the shores. The latter deals mostly with the floating life of the waters, and it is included in our plankton studies. The term plankton is applied to the plant and animal life that moves with the currents. Floating algae and such minute swimmers as the microscopic crustacea would be included, while fish and other free swimmers would be excluded. It is an occasion of surprise to some to find that the quantity of such matter in any large body of water is so great that the fixed plants along the shore, and the animals they harbor, are comparatively insignificant in a consideration of the total life.

The number of individuals in a lake like the Flathead is beyond comprehension, and the number of separate species is large. The quantity of life if collected in one mass would weigh thousands of tons.

We know that the total amount varies greatly from season to season, and it will be soon shown that there is reason to believe that there is quite a range of variation in the relative numbers of organism from year to year.

We are learning something of their daily movements in summer. To undertake the studies of quantity and composition requires additional means of transportation, apparatus time, and literature, and an infinite supply of patience. Time and patience can not be purchased in the markets, so the plankton student must bring these with him.

If you care to make the trip go with me in the Missoula and we will push over to Station B. This location will be plain enough to you if you take the bearings. Station B, is at the crossing of two imaginary lines drawn one from the point of the delta to the club house, and one from the rocky point in the bay, down the middle of the bay. (See Plate XLVIII). The other stations are located by a similar method. From soundings we find we have eighty feet of water. The temperature at the surface and at various depths, the time of day, the nature of sky and water are recorded. The Kofaid net of fine bolting silk is then carefully adjusted over the side of the boat, and the pump and hose made ready to use.

Pumpings are now made at the surface by holding the end of the hose from one to three inches from the top. This catch is put into carefully labelled bottles with numbers corresponding to those in a note-book, where the data before mentioned are kept. The plankton is preserved in a one per cent solution of formaldehyde. Other pumpings are made at three, seven, fifteen, twenty-five, fifty feet, and to the bottom, and the collections properly labelled. We then proceed to similar operations at the other stations.

We have endeavored to make daily collections the past two years while the station is open. You can readily see how valuable would be one year's continuous work, daily if possible, to discover seasonal changes.

Let us now go to the laboratory and examine the collection. We usually tow the net over the surface, and have taken very many bottles of this material. We will examine an average sample from a representative bottle, under the compound microscope. You will be delighted with the beautiful forms, the delicate desmids and diatoms, and those wonderful creatures classed broadly as microscopic crustaceans, and more properly as entomostraca. Note the beauty and variety of this life, and then I doubt not you will be seized with a desire to know their names and uncover their secrets. We would soon have you dissecting out the fifth feet and noting other characters, for we must classify whether we like it or not. Then we are ready to count forms, study movements, or go more deeply into their reason for being. You could not long question the motives of the enthusiastic student, and you would probably soon find yourself as deeply into the problem. "You have but to look at life and you will find it interesting, in whatever form, or from whatever standpoint you view it."

For the second reason I gave a hint as to the economic interest. We may be charged with magnifying this side of the question, since it is from the ceonomic point that we solicit aid in carrying on the work. But the United States Fish Commission would not have been organized in the interests of pure science. It is supposed to deal with problems that affect the food and labor of millions. There were two reasons given for its creation. (1) "An investigation into the cause of the decrease of the seacoast fishes and those of rivers and lakes, with suggestions as to the best methods of restoring the same; and (2) active measures looking toward the propagation and multiplication of the useful food fishes, either by restocking the depleted waters, or by introducing desirable species into new localities."

Allow me to quote from Prof. Reighard on the subject. "In this country the fisherman continues to fish in any locality until it becomes unprofitable. He then moves his base of operations to new waters, until these in turn have been exhausted. He is apt to look upon each new body of water as inexhaustible, and rarely has occasion to ask himself whether it is possible to determine in advance, the number of fish that he may annually take from the water without depleting it.

"On the other hand the fish culturist is likely to plant the fry in waters that are quite unsuited to them; or to plant them in water far to the excess of what the water can support. The fisherman proceeds as a farmer might who imagined that he could continually reap without either sowing or fertilizing; while the fish culturist proceeds often as if convinced that seeds might grow on barren soil, or that two seeds might be made to grow in place of one."

Now, since the whole structure of animal life rests ultimately upon vegetable life, large or small, and since most fish feed upon food produced in the water, we must readily see the interdependence between the larger and the smaller animals and plants. The food of our game fishes, as you know is live animals. The food of these animals is no doubt smaller living creatures; and so you may follow the series down to the smallest animal, one who can find no smaller victim. Among this lower class are the copepoda. Their food is largely vegetable, and they are no doubt an important element in the survival of the game fish during that critical period of youth. Together with aquatic insects they make up the food of the small fry of the game fishes. In the ocean they form the food of the whale. They are a connecting link in animal life. No man can foresee what would result, and few would believe if told,—if these insignificant animals should cease to be.

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BY
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Principal Fergus County Free High School, Member American Ornithologists' Union
Author of "Some Common Birds," "Summer Birds of Flathead Lake," Etc.

WITH INTRODUCTION BY MORTON J. ELROD.

Prepared at the University of Montana Biological Station, Bigfork, Mont.,
Under Direction of Morton John Elrod.

University of Montana, Missoula, Montana, U. S. A.
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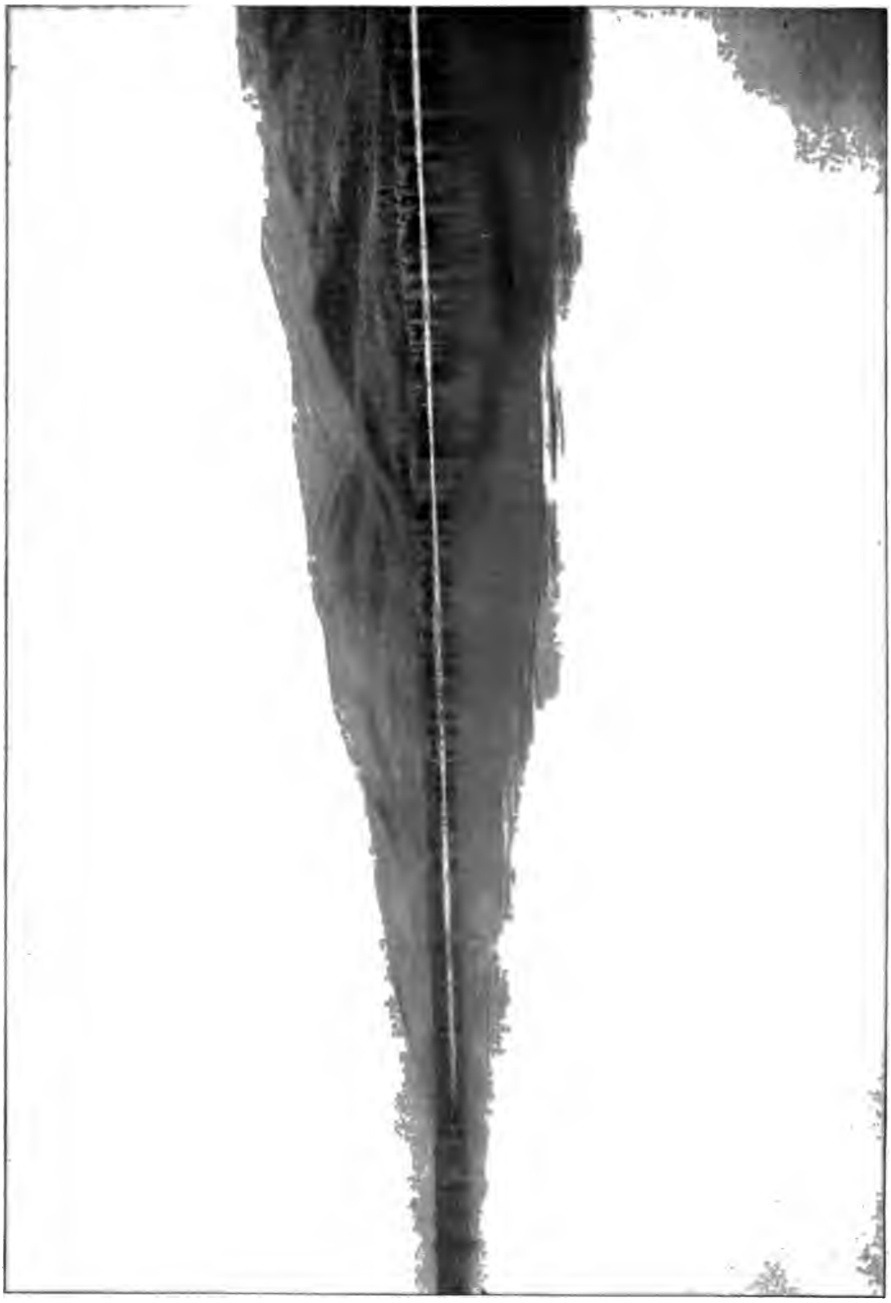

Upper end of Swan Lake, showing the swampy shore and wooded slopes of Mission Range. Photo in July by M. J. Elrod. The view is S. W.

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Introduction.

The notes presented in this bulletin, when added to the bulletin Summer Birds of Flathead Lake," University of Montana Biological ieries No. 1, include the work on ornithology during the summers of 1900, 901, 1902 and 1903. Three seasons having been spent in the Mission Iountains, on the Flathead Indian Reservation, and along the shores of 'lathead lake, it was thought best to extend the observations in the ımmer of 1903. Prin. Silloway was therefore recommended to spend a ortion of the time in the vicinity of Swan lake.

This lake is a beautiful sheet of water, cradled between two ranges mountains, with wooded slopes to the water's edge. It is primitively ild, with miles of woodland, interspersed occasionally with open glades.

Only a few hardy pioneers have entered the region. The birds have ıus not been molested by man, and a visit to the region gave opportunity r study not heretofore made.

The illustrations here given are as faithful a portrayal of the region bout Swan lake as can be made with the camera. Plate LIII shows the egion to the southeast, with the Mission range in the background. The ıountain slopes to the low summits are covered with a dense forest. ordering the lake may be seen a fringe of willows, back of which are ıe cottonwoods and alders, and lastly the conifers. A large area borderıg the water is swampy, shown in Plates LIV and LV. It is exceedingly ifficult to get around in this region. Plate LVI shows the location of ıe lake with regard to the mountains, while Plate LVII shows a large poron of the wooded valley south of and above the lake. With the excepion of a section of country including the lower portion of the lake as hown in Plate LV all of the country shown in the photographs is in the ewis and Clarke forest reserve.

The notes here presented by Prin. Silloway contain several important eatures worthy of special mention. One point is the calamity that often efalls the old birds or the young. Another is the fact that birds occupy nfinished nests, which contain eggs. This latter may be due to the ıziness or shiftlessness on the part of the mother, or to her inexperience, 'hich prevents rapid working, or to the destruction of a first nest. The nding of a nest of the Willow thrush, which ordinarily builds close to the round, six and one-half feet up in a tree, will be of interest to students of nimal intelligence, as illustrating the change of habit due to environıent. The region overflows annually. Irregular habits of nidification 'ere also found in the cedar waxwing. Indeed, the notes so carefully repared show quite plainly great individuality in the construction of the ests.

Since Bulletin Biological Series No. 1, Summer Birds of Flathead ake, is out of print it is considered advisable to print a list of the summer irds thus far discovered, which is appended. This list therefore inludes all the summer birds which have been observed about Flathead ıke, numbering 137.

MORTON J. ELROD.

Missoula, Mont., Sept. 19, 1903.

Further Notes on the Summer Birds of Flathead Lake.

The following notes are based upon observations made from May 30 to July 30, 1902. The first three weeks of June were spent at the head of Swan lake; the remainder of the time was given to observation in the immediate vicinity of the Biological Station. As a supplement to the notes made during the seasons of 1900 and 1901, which were reported in the bulletin entitled "The Summer Birds of Flathead Lake," issued under the direction of the University of Montana Biological Station, these further notes are deemed worthy of publication. Several important species, overlooked in the previous seasons, were noted in 1902; and as a complete record of our observations for the region is desirable, the notes herein given will serve to fill out somewhat that which was lacking in the larger bulletin. As previously stated, no attempt has been made to furnish a complete list of the birds of the Flathead region, but simply to report such observations as were made by our party during the collecting season; hence no authorities have been cited. It is merely intended to furnish a record of personal work that may be helpful to other observers.

SWAN LAKE.

Among the many little lakes which lend interest and beauty to the Mission, Swan, and other ranges of our Montana mountains, Swan lake is worthy of consideration because of many delightful features. It is an expansion of Swan river, or the Big Fork, the outlet of the lake into the river being about eight miles overland from the Biological Station, in a direction somewhat south of east. A very poor road, generally overflowed during the time of high water in the spring, but tolerably passable at other times, leads from the Station to the foot of the lake. Another road, generally in ordinary condition, follows a course around the bend of Swan river to the northward, thus furnishing access to the lake at all times, the distance over this road being about fifteen miles.

In its origin the lake bed is probably the result of glacial action, whereby in remote ages an irregular furrow was ploughed by the moving ice-mass. The situation is between the northern end of the Mission range and the southern end of the Swan range, and nearly parallel to the eastern shore of Flathead lake. From the tops of the Mission summits between the two lakes, both can be easily seen, the separating crests being not more than five or six miles in breadth.

Swan lake is said to be about twelve miles in length, and the average width is at least half a mile. The contour of the lake is formed by several successive slightly cresentic bays or enlargements. At its head it opens out into a nearly circular area about two miles in diameter, above which lies a large submerged region in the spring, though later it becomes a meadow covered with a rank growth of coarse grass. The western side of the lake is bounded by gradual slopes of the dwindling Mission mountains, presenting vast areas of evergreen forest, part of which is in the domain of the Lewis and Clarke forest reserve. On the eastern side of the lake are the rugged, fire-swept, or rocky heights of the Swan range, rising quite abruptly from the water's edge.

The swampy area at the head of Swan lake was the scene of most of our activities during the first three weeks of June. At that time it was covered with dead water from two to four feet in depth most of the new growth not having yet appeared above the water. Here and there were patches of old reeds, browned and tangled, with a few green reeds struggling toward the light. In this swamp we found holboell's grebe in a small colony. American golden-eyes were leading forth their broods for their first practice on the water; a few yellow-headed blackbirds were hoarsely piping in the reeds. Overhead a pair of bald-headed eagles, the male a magnificent specimen with regal white head and snowy tail, soared or flapped lazily from range to range, seeming not to care to molest the industrious ospreys that used this most convenient fishing-ground. Now and then a sora could be startled from its haunts in the reeds, or a marsh wren would amuse us with its squeaky songs. Mallards were regularly feeding in the grass; while occasionally the booming of the American bittern announced its presence in the bog.

The forested margin of the lake was populous with birds. In the twilight depths the varied thrush flitted here and there; frequently a black-headed jay uttered his harsh warning, and watched the observer from a treetop. Pheasants, the gray ruffed grouse, were nesting commonly in the neighborhood. About our cabin Cassin's purple finch was a regular visitor. Indeed, it is certain that no other portion of the Flathead lake region is tenanted by a greater number of species than the swampy area and the immediate neighborhood of Swan lake, and to make special mention of any inhabitants of the locality would serve only to mislead the reader regarding the occurrence of others.

Oological Notes.

Of several species, quite common throughout the Flathead region, no nests were met with in the seasons of 1900 and 1901. Notes made concerning such as were found nesting in 1902 may be of interest, though little new or unusual was observed in the nidification thus described.

A nest of the western robin, **Merula migratoria propinqua,** was found on May 31, at Polson. It was in a low crotch of a haw tree, and contained three eggs. Thinking that the set was incomplete, I visited the nest on the following morning to note progress, when I found only two eggs in the nest. It was evident that some marauder had despoiled the home of part of its contents. I was unable to follow the fate of the nest, but it is likely that on a future occasion, when the owner returned to her nest after an outing, she found it empty. Last season I noted a similar occurrence in the history of a nest of Wright's flycatcher, **Empidonax wrightii.** Each successive day the set showed a decrease of one egg, until finally only the empty nest remained. It would be interesting to know the particular despoiler of each of these wildwood homes.

In view of the extended notes given concerning the nidification of the olive-backed thrush, **Turdus ustulatus swainsonii,** in the larger bulletin, it may seem superfluous to add anything of like nature in these pages. However, the following may not be out of place. A deserted nest of olive-backed thrush was found on July 6, containing two eggs. The site was an upright crotch of a small fir, perhaps the lowest in my observation, the brim of the nest being not more than three feet from the ground.

Deserted nests of this thrush are chanced upon quite frequently. One fell under my notice on July 9, on the Helena club grounds near the road. It was in an upright crotch of a dead oblique fir, about seven feet from the ground. It was a very bulky nest, the walls averaging one and one-fourth inches in thickness. They were made of coarse dried grass, lichen, skeleton leaves, and punky material, the unfinished interior being mainly of skeleton leaves. This nest contained four eggs, rather advanced in incubation.

In several instances I have observed the olive-backed thrush sitting in the unfinished, empty nest. On July 6, I noticed a female sitting in a nest of which the foundation was scarcely laid. Apparently she was not working on the nest, shaping it to her form, but sitting quietly as if incubating. On July 19, I inspected this nest, and then it contained three eggs advanced in incubation. Once before this season I noticed a female sitting in her unfinished nest. It is worth mentioning that on both these occasions the day was showery, and the weather may have influenced the bird in its action.

As in each of the two preceding seasons, one nest of the willow thrush, **Turdus fuscescens salicicola,** was found, and the different site it occupied makes it worthy of mention. It was in the swampy area west of the Station grounds, bordering the harbor. Instead of being situated near the ground, it was six and one-half feet above, in an upright crotch of an oblique thorny sapling. The nest was typical of the willow thrush in construction, but the site was so unusual in my experience that I collected the owner for complete identification. It was a bulky structure, made of coarse weed-stems, pine needles, and bark, lined with fine black rootlets. A large piece of green leaf, which had probably fallen into the nest, had been incorporated into the lining. The cavity averaged two and three-fourths inches in diameter, two inches deep. The eggs were unspotted, of the greenish-blue color characteristic of this species.

One nest of the long-tailed chickadee, **Parus atricapillus septentrionalis**, was found. It was at the head of Swan lake, on June 6, at which date the eggs were about ready to hatch. The site was an old cavity made by a small woodpecker or the owner, in an old decayed birch stump in the swampy margin of the lake. The nest was a soft bed of rabbit fur. There were seven eggs in the nest.

On July 1, a nest of Parkman's wren, **Troglodytes aedon parkmanii**, was examined. It was on the tract known as the "Big Burn," on the Mission slopes southeast of the Station, in a cavity made by a woodpecker in a decayed stump. The nest was made of dead twigs for a foundation, weed-fibers, soft feathers, and pieces of sloughed snake skin. There were two fresh eggs in this nest.

The catbird, **Galeoscoptes carolinensis**, nests very commonly in the region about Daphnia Pond. On July 7, I found my first nest of this species containing five eggs. One of these was infertile, and the others were quite advanced in incubation. The catbird prolongs its nesting season, though later sets of eggs contain less than the regular complement of four of earlier nesting. On July 16, we noted a nest containing three eggs, and on July 22 another nest was found with three eggs. All of these nests were in the low buckbrush growing so plentifully on the ridges near the Station.

A nest of the cedar waxwing, **Ampelis cedrorum**, seemed to indicate irregular habits of nidification of this species. The nest was noticed on June 27. It was situated in a fir in the edge of the Station grounds, near the top of the tree and about twelve feet from the ground. It was made on horizontal branches, against the main stem, from which site it was removed when first noticed, examined, and replaced to wait for later examination. It then contained three eggs. On June 30, it contained four eggs. On July 1, when the eggs were further examined, three of them were incubated very noticeably beyond the fourth, a condition showing that the eggs were not deposited on successive days, or that the three eggs had been incubated several days longer than the fourth.

The western vesper sparrow, **Poocaetes gramineus confinis**, nests abnudantly near the shore of Flathead lake. In the meadow opposite to the store at Polson, five nests were found, and another nest was noted just outside the fence, in the bushes bordering the lake. On May 31, a nest was taken from a depression at the base of a grass tuft. It was made of coarse dried grass and horsehair. Cavity two and three-eighths inches in diameter, depth one and one-half inches. The depression was on the shady and darkest side of the grass tuft. There were four eggs, fresh. The eggs of this sparrow are pale greenish-white, irregularly marked with spots of reddish-brown. On May 30, a nest of the western vesper sparrow was found in a depression at the base of a little bush, beside a path between the meadow and the lake. It contained three eggs, which were somewhat incubated. Another nest noted on May 31 with three eggs, on June 2, contained only two eggs. Another examined on June 2, contained one youngling just hatched, one egg breaking for the struggling occupant, and two eggs. Another nest noted on June 2, held four fresh eggs; another held four fresh eggs, and still another contained three eggs far advanced in incubation. All of these nests were made after a common plan of structure, and were on the darkest side of the tufts under which they were placed, a characteristic not usually noticeable in the sites of most of the ground-nesting species, and indeed not generally characteristic of the vesper sparrow.

Brewer's blackbird, **Scoleophagus cyanocephalus**, was commonly nesting in the low bushes near the lake shore at Polson. On May 31, a nest of this species was taken from a bush in a clump. The site was twelve inches from the ground, among upright stems. The nest was made of coarse weed-stems and twigs, with muddy material in the walls, and a bedding of horsehair. The cavity was three and three-fourths inches across, and two and three-fourths inches deep. This nest contained six eggs, partially incubated. A second nest contained three eggs of the owner and one of the cowbird. The eggs of Brewer's blackbird are dark greenish-white, variously marked with blotches of dark brown.

At Selish, a nest of the western meadowlark, **Sturnella magna neglecta**, was observed on the hillside back of the hotel. It was made in typical manner, of coarse dried grass, in a tuft of tangled dead and green grass, well arched at the top. There were five eggs, partially incubated. They were very handsomely marked, having large, bold blotches of reddish brown on a snowy background.

Traill's flycatcher, **Empidonax traillii**, has been mentioned as nesting throughout this region. On July 8, a nest of this flycatcher was found in a small fir in the edge of the Station grounds, within arm's reach of a path leading down into the swampy area. It was placed upright on horizontal twigs beside the main stem, six feet from the ground. When first noticed it contained three younglings about ready to leave the nest. In structure the nest is much like that of the yellow warbler, **Dendroica aestiva**, or that of Wright's flycatcher, **Empidonax wrightii**, being made of strippings of weed-stems, grass stems, and bits of gossamer. On July 6, after a cold rain of a week's duration, a nest of Traill's flycatcher was noticed containing three young birds about half fledged, dead, doubtless from exposure.

A nest of the western wood pewee, **Contopus richardsonii**, was noticed near the Station on July 8. It was in an aspen on the lake shore, saddled upon a dead branch at a fork about three feet from the main stem, and about fifteen feet from the water below. In attempting to examine it, I accidentally spilled the four eggs, and the nest dropped into the water and was almost immediately disintegrated. The eggs were found to be far advanced in incubation. Another nest of this species was noted on July 17, in a large fir tree on the shore of the lake near the Station. It was about fifteen feet from the ground, near the extremity of a large dead horizontal branch, the site being at least ten feet from the trunk of the tree. As in the former instance, the nest was made upon a horizontal fork. Fearing that the accident in the former case might repeat itself, we did not attefpt to examine this nest, and left the female sitting contentedly upon her breezy home. The eggs of the western wood pewee are creamy yellowish-brown, blotched irregularly with reddish-brown.

The western nighthawk, **Chordeiles virginianus henryi**, nests abundantly on the rocky ridges near the Station. A set of two eggs of this nighthawk was found June 26, on the rocky ridge west of the road leading to Holt. The sitting bird was startled within three feet of me as I ascended the rock. She flitted painfully away for about twenty feet, and sat fluttering for several minutes; then she flutered over the edge of the cliff and disappeared. The eggs were on a portion of bare rock surrounded by brown moss, the bare spot being not more than three inches square. The eggs were advanced in incubation. They are a dark stone gray, variously marked with spots and blotches of dark brown. On July 1, I chanced upon a sitting nighthawk on the rocks east of Daphnia Pond. Upon being flushed, she flew away low and heavily. Only one egg was found, far advanced in incubation, and I fancied that the parent bird had carried away an egg or a young recently hatched. The egg was on the bare rock or earth which scantily covered the rock, though a few small sprouts were growing near. On July 19, a set of two fresh eggs was found on these rocks.

Several nests of the gray ruffed grouse, **Bonasa umbellus umbelloides**, were examined. One found on June 7, at the head of Swan lake, was made about eight feet from a trail used frequently by trappers. It was under the upturned end of a fallen log, in warm exposure, made of dead leaves in a depression, with half a dozen soft feathers. The depression measured seven inches across at the top, and was two and one-half inches deep. There were ten eggs, partialy incubated. They are a light reddish-cream color, having few faint indistinct specks of reddish-brown. On June 15, a nest of this grouse was noted with six eggs. It was at the base of a small fir, made as before described, and like the other, it was near a trail and not closely concealed. On June 20, the nest was empty, the eggs having evidently hatched, and the place was deserted. Another nest of the ruffed grouse was found on June 16, in the edge of a small clearing on Swan lake. This nest was under the edge of a fallen log, among surrounding tangled weeds that most effectually concealed the nest. It held seven eggs which were thought to be about ready to hatch.

A small colony of Holboell's grebe, **Colymbus holboellii**, consisting of at least five pairs, was found nesting at the head of Swan lake. The first nest was found on June 4, among tall dead reeds. It was made of black decaying material, with some green reeds intermingled. The mass floated about four inches above water. The nest was in the edge of a clump of reeds, about which there was clear water all around. There were five eggs, loosely covered with material similar to that of the nest. The eggs were partially incubated, and had acquired the browned, baked appearance peculiar to eggs of the grebes after lying some time in the nest. On June 7, a second nest of this grebe was found, situated in bushes on overflowed ground. It was made as usual of decaying material, with which some green reeds in short pieces were intermingled. This nest was founded on coarse dead twigs, probably brought up from the ground below. These eggs were also covered with material like that in the nest, the four eggs being somewhat advanced in incubation. Nest No. 3 was noted on June 17, with five eggs, uncovered, and quite fresh. They were of a pale greenish-white color, not having changed to the appearance described in a foregoing account. This nest was made as usual, anchored in the edge of old reeds. It is worth while to state that on June 12, this nest held two eggs, on June 14, three, and June 17, five. A fourth nest was noted June 17, with three eggs about half incubated. On June 18, another nest of Holboell's grebe was examined, which was in the willow bushes in the edge of the overflow area. It was made on depressed branches, a large strong nest, twenty-four inches across at the surface of the water, rising four inches above the water, with a cavity seven and one-half inches across, one and one-half inches deep. This nest was made as the others, of old reeds with some new material on top. There were four eggs, incubation far advanced. On June 20, a set of three eggs was found in a large nest anchored in the edge of a small clump of reeds, the eggs being partially incubated. The last nest of this series was examined June 20, and contained four fresh eggs, It was a large mass of dried decaying material anchored among thick reeds, with two opposite approaches through the reeds to open water. The eggs were not covered, but being fresh were of the bluish-white tinge.

On July 4, 1903, a nest of the Louisiana tanager was found in a tall fir tree in front of the Biological Station building. The birds were observed to frequent the place, and by close watching the female was seen to take her place upon the nest. It was about twenty-five feet from the ground, on a dwarf branch among others which were the lowest bearing vegetation. The site was a horizontal fork, and the nest was held in place by surrounding twigs. It was made outwardly of coarse forky twigs, the walls being chiefly made of fine rootlets, and there was a lining of horsehair. The cavity was two and three-fourths inches in diameter, and one and one-half inches deep. When the nest was collected the female was sitting, and she remained on the nest until I had nearly reached the branch. The tuft of twigs in which the nest was made was about four feet from the main stem. There were four eggs, about one-half incubated. They are pale bluish green, with specks of blackish brown distributed sparsely over the surface. When removed from its site, the loose twigs in the outer part of the nest fell away like that part of a grosbeak's nest.

On July 15, a nest of Townsend's warbler, **Dendroica townsendi,** was found in a clump of small firs on a rocky ridge of the Helena club grounds. The site was unusually low, being only six feet from the ground in a small fir surrounded by larger ones. The nest could be seen only by a person pushing his way into the clump. It was made beside the main stem, situated like a chipping sparrow's nest, which it greatly resembled. It was made externally of coarse weed-stems and grasses, with a lining of fine grasses and horsehair. The cavity was two inches in diameter, and one and three-eighths inches deep. The nest contained five young which were nearly fledged, showing the black crown and yellow superciliary line, and wing-bands. All the young were infested with a parasitic grub, which had eaten a hole in the skull and neck; it appeared that the brain had been entirely destroyed by the wriggling occupants of the cavity, though the younglings were apparently enjoying life and were eagerly stretching forth their mouths at the approach of the parents. The male seemed most active in bringing in supplies, and he was collected with little difficulty. The female was shyer, and only by considerable waiting and watching was the collector able to secure her.

On July 6, 1903, a nest of the ruby-crowned kinglet, **Regulus calendula,** was collected, with both parent birds. This nest was along a road through the Helena club grounds. It was situated about fifteen feet from the ground, near the extremity of a branch of a medium-sized fir tree. The site was six feet from the main stem. The nest was partially saddled on an oblique twig on the under side of the branch, and was also somewhat pendent from several smaller twigs about which the walls were woven. The nest was four inches in diameter externally, and three inches deep. The opening was two and one-fourth inches across, and the cavity was one and seven-eighths inches deep. The nest walls were made of dark green lichens common in the tamarack forest, deer hair, gossamer, and shreds of bark. The lining was made of hair, soft downy feathers, and lichen. There were eight young in the nest, ready to leave in two or three days at most.

Notes on New Birds.

167. Ruddy Duck, **Erismatura jamaicensis** (Gmel.)

This handsome little duck was met with in the summer of 1901, on a small pot-hole on the Flathead reservation. The watery area was about an acre in extent, margined by a thick growth of grass. As we passed it somewhat hurriedly, we noticed several ducks on the water. Loitering behind the others, I made a circuit of the pond, and at one place I came upon a wounded duck crouching in the grass, almost under my feet. Before I could capture it, the duck revived and swam out into the deeper water. However, I could not fail to recognize the reddish-chestnut of the back, and the black of the head, nor the little tail left so jauntily erect. Indeed, I was stooping to pick up the duck when it glided away from my reach. It is likely that several pairs of this duck were nesting on the little pond where they were seen.

206. Sandhill Crane, **Grus mexicana** (Mull.)

The sandhill crane was observed in both the seasons of 1901 and 1902. In the former summer, on July 29, a pair of these cranes was observed standing on a stranded tree near the mouth of Flathead river. I tried to secure a specimen with the shotgun, but the great birds paid no attention to my No. 6 shot. These birds lingered near the mouth of the river for several days, but they were too wary to be taken. In 1902, when we were encamped at the head of Swan lake, July 26, a sandhill crane flew overhead, circling somewhat uneasily about the place, and finally alighted in the meadow, but was not thereafter observed.

221. American Coot, **Fulica americana** Gmel.

The American coot eluded our notice until the spring of 1902, when it was observed in the swamp at the head of Swan Lake. On the morning of June 6, two individuals were seen feeding, and as they paid little attention to our quiet movements in a skiff, we watched them for some time with considerable interest. Hoping that they might be nesting in the swamp, I refrained from taking a specimen at that time. However, they were not seen again, and there was no evidence of their nesting there. We were told by trappers in the neighborhood that the coots assembled in the swamp in the fall in hundreds.

225. American Avocet. **Recurvirostra americana.**

The American avocet was not noted in the Flathead region until 1903, when a single specimen was observed on August 11, at the mouth of Flathead river. It was feeding on the sand-bar in company with several Baird's sandpipers and some ring-billed gulls. An effort was made to secure it, but it flew away with a broken leg and we were unable to capture it. However, there can be no doubt regarding the indentification, as the species is well-known to me from previous observation.

357. Piegon Hawk, **Falco columbarius** Linn.

A fine specimen of pegion hawk was taken on the Station grounds on July 19. It flew into one of the trees soon after sunset, moving restlessly from one tree to another until my attention was directed to it. My first impression was that it was a sparrow hawk, but thinking best to secure it, I caught it by a lucky shot as it was leaving the grounds. It presented the following measurements: length, 11.15 inches; wing, 7.80 inches; tarsur, 1.30 inches; culmen to cere, .50 inch; tail, 5 inches; middle toe to claw, 1.15 inches; extent of wings, 23 inches. Iris, brown; cere, tarsi, and feet, yellow; mandible, greenish-yellow basally, bluish horn at tip. The specimen proved to be a male, and was in splendid plumage in almost perfect coloration.

358. Richardson's Merlin, **Falco richardsonii** Ridg.

A male of this species was taken at the head of Swan lake on July 26. It was apparently a young of the year, as the rusty markings predominated in its plumage. The specimen presented the following approximate measurements: length, 12.50 inches; wing, 8.60 inches; tail, 5.75 inches; tarsi, 1.35 inches; culmen to cere, .55 inches; middle toe to claw, 1.32 inches.

379. Pygmy Owl, **Glaucidium gnoma** Wagl.

This interesting little owl occurs regularly throughout the wooded parts of the Flathead lake region, but it eluded our notice until 1902. During the protracted rains of the first week of July, we were kept generally indoors, but in an afternoon walk between showers, Mr. Ricker saw a specimen of this owl near the Station and described it very accurately to me. It was not until July 17, that it chanced under my observation, when three specimens were taken from a family which was taking an afternoon outing along the road through the woods south of the bridge at Bigfork. One of the owls was sitting in a small tamarack beside the road, almost within reach of passing teamsters. When it was shot, the others flew from perches nearby, and alighted in the largest trees not far away. They perched in each instance on horizontal branches close to the main trunk. When flushed, they uttered a faint shrill whistling call. One of the family, the female in charge of the youngsters, uttered a low cooing whistle, in low pitch.

It was reported to me that specimens of tne pygmy owl were at Kalispell. Mr. Ernest Bond also told me that this owl was frequently taken at the head of Swan lake. (It is also found at Missoula. M. J. E.)

497. Yellow-headed Blackbird. **Xanthocephalus xanthocephalus.**

This species was found sparingly in the swamp at the head of Swan lake, the first being noted June 7, when both males and females were seen. Thereafter specimens were seen every day that we visited the swamp, until June 21, during which time the males were in song. As far as I could observe, there were no nests in the swamp. No specimens were taken, as I did not wish to interfere with the nesting of this species by sacrificing the lives of any of the colony.

675a. Grinnell's Water-Thrush. **Seiurus noveboracensis notabilis.**

This water-thrush was heard regularly in the swampy woods at the ead of Swan lake, singing cheerily from the tangled bushes, but it ıanaged to elude capture until July 10, 1903, when it was still in song. t was also heard in the swamp-woods near the mouth of Swan river. 'here is no doubt that Grinnell's water-thrush breeds in suitable localities a the Flathead region.

725c. Western Marsh Wren. **Cistothorus palustris plesius** Ober.

A specimen of this wren was taken in the marsh at the head of Swan ake, July 26. It was singing vigorously, and near it an unfinished nest ras found, the only evidence of its nesting.

763. Varied Thrush. **Ixoreus naevius** (Gmel.)

The varied thrush was found to be common at the head of Swan lake, rhere it flitted in the dark forest of the mountain-sides. An old nest ras brought to me, containing fragments of shells easily indentifiable. 'he nest was made like one of the olive-backed thrush, outwardly of wigs and lichens, lined with soft whitish fibers. It is reported to nest ery early. The trappers in the neighborhood, and the person who rought me the nest, asserted that this species is a winter resident as 'ell in this region.

List of Birds.

List of the Summer Birds of Flathead lake, including those given in the former bulletin and those added by the present bulletin.

1. Colymbus holboellii. Holboel's Grebe. A small colony found breeding at the head of Swan lake, 1902.

2. Colymbus nigricollis californicus. American Eared Grebe. Young reared in Sinyaleamin lake, Missoin Mts., 1901. Also at Rost lake.

3. Urinator imber. Loon. Common, breeds.

4. Urinator lumme. Red-throated Loon. Specimens taken at Flathead lake and at Rost lake, 1901.

5. Larus occidentalis (?). Western Gull. One specimen, doubtfully identified, taken at the mouth of Flathead river.

6. Larus delawarensis. Ring-billed Gull. Common at Flathead lake.

7. Sterna forsteri. Forster's Tern. One specimen taken from a small flock, Aug. 23.

8. Merganser americanus. American Merganser. Noted regularly after Aug. 23, 1901.

9. Lophodytes cucullatus. Hooded Merganser. A female taken July 15, 1901, at Rost lake.

10. Anas boschas. Mallard. Common, breeds.

11. Nettion carolinensis. Green-winged Teal. Common after the middle of August.

12. Dafila acuta. Pintail. Common, breeds.

13. Aix sponsa. Wood Duck. A male young-of-the-year taken July 31, 1901, from a small flock.

14. Clangula clangula americana. American Golden-eye. The commonest of the breeding ducks of the region, seen on every little body of water.

15. Charionetta albeola. Buffle-head. Not common, breeds.

16. Erismatura jamaicensis. Ruddy Duck. Found breeding on the pot-holes of the reservation.

17. Branta canadensis. Canada Goose. Common, breeds.

18. Botaurus lentiginosus. American Bittern. Common, breeds.

19. Grus mexicana. Sandhill Crane. A pair seen July 29, 1901, at the mouth of Flathead river.

20. Porzana carolina. Sora. Common, breeds.

21. Fulica americana. American Coot. Seen only at the head of Swan lake early in June, 1902.

22. Phalaopus lobatus. Northern Phalarope. A specimen taken on Flathead lake August 27, 1900.

23. Gallinago delicata. Wilson's Snipe. Common after the middle of July.

24. Tringa bairdii. Baird's Sandpiper. Occurs regularly after the middle of August.

25. Calidris arenaria. Sanderling. Common toward the end of August.

26. Totanus melanoleucus. Greater Yellowlegs. Common.

27. Totanus flavipes. Yellow-legs. Common.

28. Helodromus solitarius. Solitary Sandpiper. Occurs regularly toward the end of July and thereafter.

29. Bartramia longicauda. Bartramian Sandpiper. Occurs locally, breeds.

30. Actitis macularia. Spotted Sandpiper. Abundant, breeds.

31. Numenius longirostris. Long-billed Curlew. Common, breeds.

32. Aegialitis vocifera. Killdeer. Common, breeds.

33. Colius virginianus. Bob-white. Introduced, increasing between Bigfork and Kalispell.

34. Dendragapus ogscurus richardsonii. Richardson's Grouse. Occurs in the mountains near the lake.

35. Dendragapus franklinii. Franklin's Grouse. Occurs in the higher mountains.

36. Bonasa umbellus umbelloides. Gray Ruffed Grouse. Abundant.

37. Pedioecetes phasianellus columbianus. Columbian Sharp-tailed Grouse. Abundant in the open prairie regions.

38. Zenaidura macroura. Mourning Dove. Occurs regularly, but not numerous, breeds.

39. Circus hudsonius. Marsh hawk. Common at the foot of Flathead lake.

40. Accipiter velox. Sharp-shinned Hawk. Common, breeds.

41. Accipiter cooperii. Cooper's Hawk. Not numerous, breeds.

42. Buteo borealis calurus. Western Red-tail. Not uncommon, breeds.

43. Archibuteo lagopus sancti-johannis. American Rough-legged Hawk. Seen frequently in flight high overhead.

44. Aquila chrysaetos. Golden Eagle. Common.

45. Haliaeetus leucocephalus. Bald Eagle. Several pairs living in this region.

46. Falco columbarius. Pigeon Hawk. A fine specimen taken July 19, 1902.

47. Falco richardsonii. Richardson's Merlin. A young of the year taken at Swan lake, July 26, 1902.

48. Falco sparverius deserticolus. Desert Sparrow Hawk. Abundant.

49. Pandion haliaetus carolinensis. American Osprey. Common, breeds.

50. Asio wilsonianus. Long-eared Owl. One specimen seen at Selish.

51. Megascops asio maxwelliae. Rocky Mountain Screech Owl. A specimen taken at Post creek, on the reservation.

52. Bubo virginianus subarcticus. Western Horned Owl. Common in the wooded districts.

53. Glaucidium gnoma. Pygmy Owl. Several specimens taken in 1902.

54. Ceryle alcyon. Belted Kingfisher. Abundant.

55. Drybates villosus hyloscopus. Cabanis's Woodpecker. Common.

56. Dryobates pubescens oreoecus. Batchelder's Woodpecker. Common.

57. Picoides arcticus. Arctic Three-toed Woodpecker. Not uncommon.

58. Picoides americanus dorsalis. Alpine Three-toed Woodpecker. Not uncommon.

59. Sphyrapcus varius nuchalis. Red-naped Sapsucker. Common, breeds.

60. Ceophloeus pileatus. Pileated Woodpecker. Common in the heavy woodlands.

61. Melanerpes torquatus. Lewis's Woodpecker. Common.

62. Colaptes cafer. Red-shafted Flicker. Abundant.

63. Chordeiles virginianus henryi. Western Nighthawk. Abundant.

64. Selasphorus rufus. Rufous Hummingbird. Common, breeds.

65. Stellula calliope. Calliope Hummingbird. Not uncommon.

66. Tyrannus tyrannus. Kingbird. Abundant, breeds.

67. Tyrannus verticalis. Arkansas Kingbird. Common, locally, breeds.

68. Contopus borealis. Olive-sided flycatcher. Not uncommon on the mountain slopes.

69. Contopus richardsonii. Western Wood Pewee. Common.

70. Empidonax traillii. Traill's Flycatcher. Common.

71. Empidonax wrightii. Wright's Flycatcher. Common.

72. Otocoris alpestris arenicola. Desert Horned Lark. Abundant on the prairies.

73. Pica pica hudsonica. American Magpie. Very common, breeds.

74. Cyanocitta stelleri annectens. Black-headed Jay. Common, breeds.

75. Perisoreus canadensis capitalis. Rocky Mountain Jay. Common.

76. Corvus corax sinuatus. American Raven. Not uncommon.

77. Corvus americanus. American Crow. Generally distributed.

78. Nucifraga columbiana. Clarke's Nutcracker. Common in the mountains.

79. Dolichonyx oryzivorus. Bobolink. Common in the fall on the reservation.

80. Molothrus ater. Cowbird. Not common.

81. Xanthocephalus xanthocephalus. Yellow-headed Blackbird. Seen only at Swan lake.

82. Agelaius phoeniceus. Red-winged Blackbird. Not very common.

83. Sturhella magna neglecta. Western Meadowlark. Abundant.

84. Spinus pinus. Pine Siskin. Abundant, breeds.

85. Scolecophagus cyanocephalus. Brewer's Blackbird. Abundant, breeds.

86. Coccothraustes vespertinus montanus. Western Evening Grosbeak. Very common in 1901 in the vicinity of the Station.

87. Carpodacus cassini. Cassin's Purple Finch. Common at the head of Swan lake.

88 Loxia curvirostra minor. American Crossbill. Generally common in late summer.

89. Spinus pinus. Pne Sisikin. Abundant, breeds.

90. Pooecetes gramineus confinish. Western Vesper Sparrow. Abundant, breeds.

91. Ammodramus savannarum perpallidus. Western Grasshopper Sparrow. Common.

92. Spizella socialis arizonae. Western Chipping Sparrow. Abundant, breeds.

93. Junco hyemalis shufeldti. Shufeldt's Junco. Common, breeds.

94. Melospiza melodia montana. Mountain Song Sparorw. Common, breeds.

95. Melospiza lincolnii. Lincoln's Sparrow. Not common.

96. Melospiza georgiana. Swamp Sparrow. One specimen taken Aug. 11, 1900, from a group of three or four.

97. Passerella iliaca schistacea. Slate-colored Sparrow. Found breeding in the woods at the base of McDougal Peak.

98. Pipilo maculatus arcticus. Arctic Towhee. Common, breeds.

99. Habia melanocephala. Black-headed Grosbeak. Common, breeds.

100. Cyanospiza amoena. Lazuli Bunting. Common, breeds.

101. Pirang ludoviciana. Louisiana Tanager. Abundant, breeds.

102. Petrochelidon lunifrons. Cliff Swallow. Common.

103. Hirunda erythrogastea. Barn Swallow. Common, breeds.

104. Tachycineta bicolor. Tree Swallow. Common, breeds.

105. Clivicola riparia. Bank Swallow. Common, breeds.

106. Ampelis cedrorum. Cedar Waxwing. Abundant, breeds.

107. Vireo olivaceus. Red-eyed Vireo. Common, breeds.

108. Vireo gilvus. Warbling Vireo. Common, breeds.

109. Dendroica aestiva. Yellow Warbler. Abundant, breeds.

110. Dendroica auduboni. Audubon's Warbler. Common, breeds.

111.Dendroica townsendi. Townsend's Warbler. Abundant, breeds.

112. Geothlypis macgillivrayis. Macgillivray's Warbler. Common, breeds.

113. Geothlypis trichas occidentalis. Western Yellow-throat. Common, breeds.

114. Icteria virens longicauda. Long-tailed Chat. Abundant at Selish, on reservation, and at Bigfork.

115. Sylvania pusilla. Wilson's Warbler. Found nesting at McDonald lake, June 24, 1901.

116. Setophaga ruticilla. American Redstart. Abundant, breeds.

117. Cinclus mexicanus. American Dipper. Common, breeds.

118. Galeoscoptes carolinensis. Catbird. Common, breeds.

119. Salpinctes absoletus. Rock Wren. Common.

120. Troglodytes aedon aztecus. Western House Wren. Common, breeds.

121. Troglodytes hiemalis pacificus. Western Winter Wren. Common.

122. Cistothorus palustris plesius. Western Marsh Wren. Noted only at the head of Swan lake, 1902.

123. Certhia familiaris montanus. Rocky Mountain Creeper. Common.

124. Sitta carolinensis aculeata. Slender-billed Nuthatch. Common.

125. Sitta canadensis. Red-breasted Nuthatch. Common.

126. Parus atricapillus septentrionalis. Long-tailed Chickadee. Common, breeds.

127. Parus gambeli. Mountain Chickadee. One specimen noted on McDougal Peak. Breeds at Bigfork.

128. Regulus satrapa. Golden-crowned Kinglet. Common.

129. Regulus calendula. Ruby-crowned Kinglet. Common, breeds.

130. Myadestes townsendii. Townsend's Solitaire. Common, breeds.

131. Hylocichla fuscescens salicicola. Willow Thrush. Not uncommon, breeds.

132. Hylocichla ustulatus swainsonii. Olive-backed Thrush. Abundant, breeds.

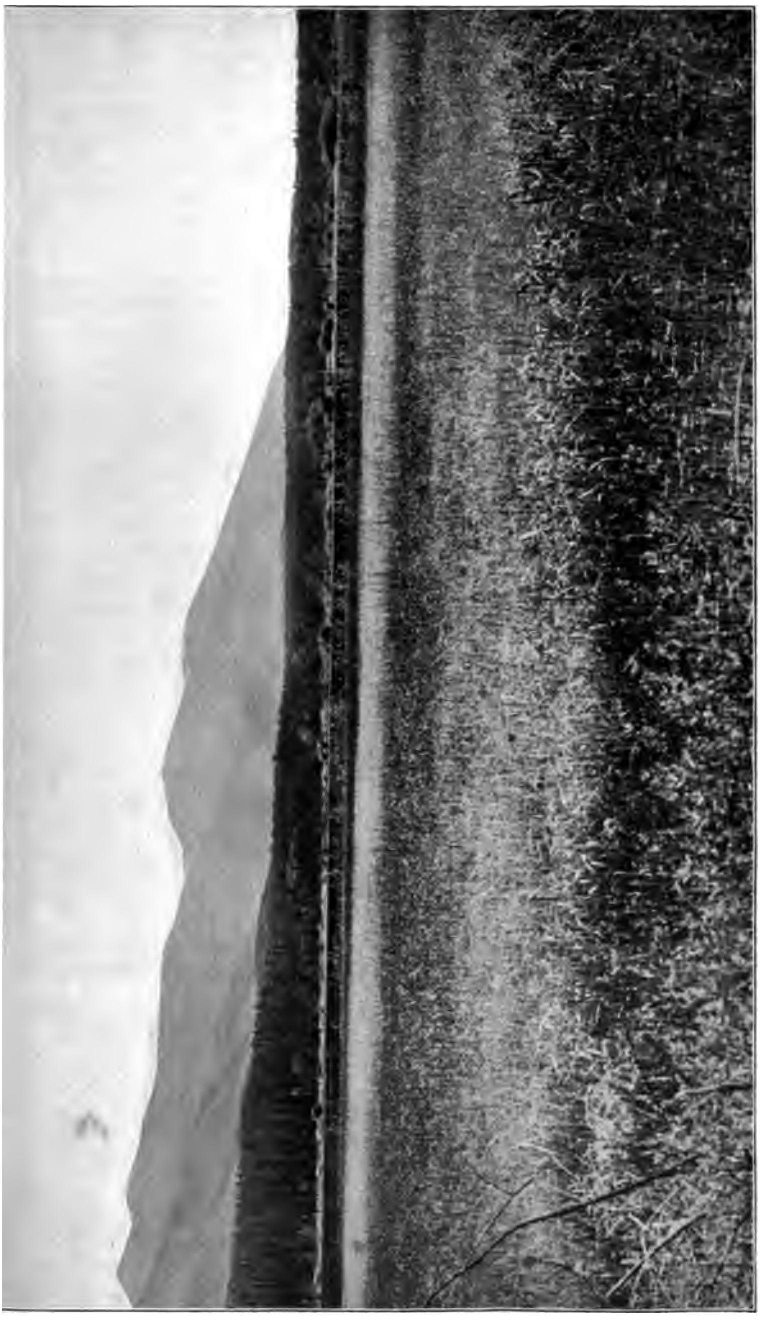
133. Merula migratoria propinqua. Western Robin. Abundant, breeds.

134. Ixoreus naevius. Varied Thrush. Common at the head of Swan lake, breeds.

135. Sialia arctica. Mountain Bluebird. Common.

136. Recurvirostra americana. American Avocet. Only one specimen observed, Flathead river, 1903.

137. Seiurus noveboracensis notabilis. Grinnell's Water-Thrush. Common, in swampy woods. Breeds.



Swamp at upper end of Swan Lake. Note the vegetation surrounding a stretch of open water, behind which is a fringe of willows, alders and swamp birches. Compare with Plate LIII. Southern end of Swan Range in the background. Photo in July, 1902, by M. J. Elrod. The view is S. E.

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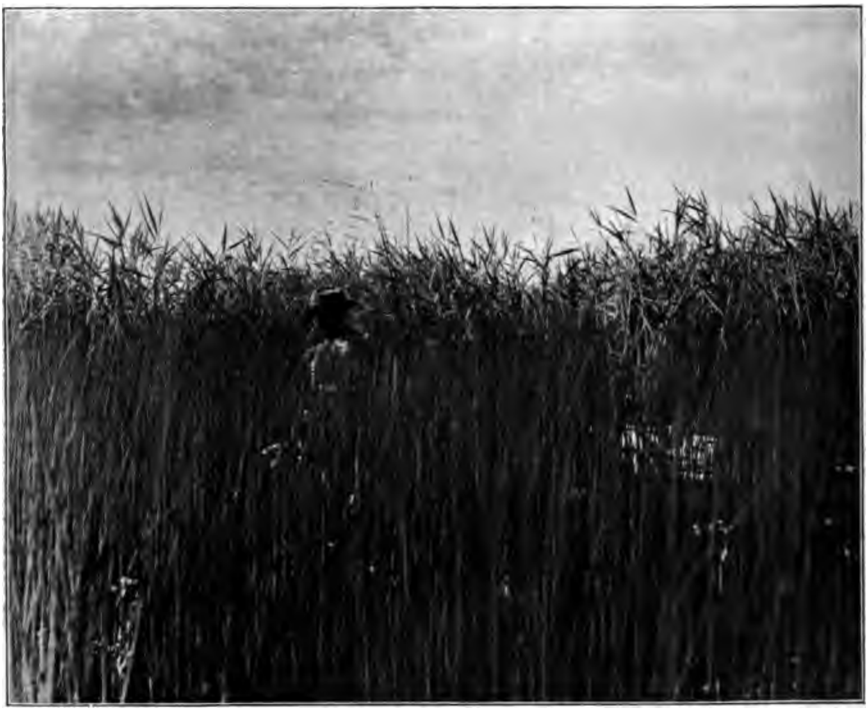

Showing height and density of the vegetation in the swamp at the upper end of Swan Lake. Photo by Maurice Ricker.

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BULLETIN UNIVERSITY OF MONTANA,
No. 19.
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Lichens and Mosses of Montana,

A LIST BASED ON MATERIAL COLLECTED DURING THE SUMMER
OF 19[illegible], WITH ADDITIONS

BY
WILSON P. HARRIS AND CAROLYN W. HARRIS

PREPARED IN CONNECTION WITH THE WORK OF THE UNIVERSITY OF MONTANA
BIOLOGICAL STATION, UNDER DIRECTION OF MORTON JOHN ELROD.

University of Montana, Missoula, Montana, U. S. A.
1904.

Entered August 24, 1901, at Missoula, Mont., as second class matter under act of Congress, July 16, 1894

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Introduction.

The material represented in this bulletin was collected by Wilson P. Harris, as will be noted later. The identifications were made by his mother, Mrs. Isaac Harris. As a basis for subsequent work I deem it advisable to record the results in permanent form, without attempting descriptions or keys for identification.

The localities marked with an * are from material collected by myself at different times, and identified by Prof. Bruce Fink. The notes enclosed in brackets are my own.

The illustrations were made at the University of Montana, due credit being given therefor. By consulting Bulletins Nos. 3, 4, 5 and 6 of the Biological Series many additional illustrations of the region may be seen, showing the character of the country, soil, mountain summits, etc.

The mosses were identified by Mrs. Elizabeth G. Britton, the well known authority for this group.

Duplicates of the collections made by Mr. Harris are in the possession of Mr. Harris and his mother, of the New York Botanical Garden at Bronx Park, and at the University of Montana at Missoula, Mont.

MORTON J. ELROD.

Missoula, Mont., June 17, 1903.

Preliminary Announcement.

These specimens were collected while I was with an expedition from the University of Montana, with the co-operation of the New York Botanical Garden, to collect biological specimens in the Flathead and Mission valleys in Flathead county, Montana. The time of collecting was about seven weeks, from the middle of June to the middle of August, 1901. The elevations varied between 2,600 and 7,700 feet above sea level.

Some collecting was done on the mountains around Missoula and in the valley of the Missoula river before the expedition set out. The mountains are steep pastured slopes, with occasional outcrops of shale. They are heavily wooded on the summits with **Pinus ponderosa** and **Pseudotsuga taxifolia**. The valley is a flat wooded plain, with a limestone silt soil and some white alkali.

The expedition travelled through the Missoula valley to O'Keefe canyon, then up this canyon to Evaro. The canyon is narrow and steep, with a small stream running through it. It is heavily wooded. The soil is scanty, with a large per cent of lime.

From Evaro the expedition travelled down to the Jocko valley, then to Selish. The valley is wide, covered with native prairie grass. From there the expedition moved to Sinyaleamin lake. This body of water is in a "pocket" in the Mission mountains. The country is heavily wooded with Engelmann's spruce, bull (yellow) pine and cedar. The soil is fine limestone silt over a glacial gravel. During the stay of five days excursions were made up the mountain sides and over the low pass to the south as far as the series of small ponds.

From Sinyaleamin the expedition moved to McDougal lake, which is about twenty miles to the north, in the same range. The timber here is principally bull pine and Douglas spruce, and is confined principally to the bottom of the valley. The mountain sides were very precipitous, covered with limestone shale and brush. Owing to the position of the lake and to the rainy weather, very little collecting was done except along the shores of the lake.

From McDonald lake a move was made to Mud creek, near its source in the mountains, a distance of thirty miles. The country is flat and heavily timbered with bull pine and larch (tamarack), with some spruce. The soil is deep rich clay loam. There is no appearance of alkali. At this place some specimens of water-loving mosses were found.

From Mud creek the next move was to the lower end of Flathead lake, on the east shore. During the stay of five days in this region collecting was done on the lake shore and well up the mountain sides. The soil and vegetation was of the same general character as that of McDonald lake.

From this place the expedition moved directly to the University of Montana Summer Station at Bigfork. From this as a base excursions were made into the Swan range. The first was to Echo lake. On this trip MacDougal peak was ascended. Camp was later moved to Rost lake. From there a trip was made to Wolf creek canyon, to Silloway mountain, then around Wolf creek head, over Craig mountain, and return to camp. Wolf creek valley is heavily timbered with bull pine, larch and Douglas spruce. On the mountain side the Douglas spruce predominates, but near the summit of the range gives way to a small scrubby pine. The soil is scanty on the hills and is covered by a species of yucca known locally as bear grass.

On this trip the **Usnea** was noticed at the elevation of 5,800 feet on the south-western slopes, and not above 5,000 feet on eastern and northern slopes.

The second trip from Bigfork was to Swan lake. No collecting was done except along shore.

The distances between the various stations have never been measured and are rather uncertain. The elevations were determined by Prof. M J. Elrod, of the University of Montana.

W. P. HARRIS.

125 St. Marks Ave., Brooklyn, Februarv 9, 1902.

List of Species of Lichens.

Acolium tympanellum (Ach.) De Not.
Bigfork, Flathead Lake, 2,960 ft., July 6, 1901.
Rost Lake, Alt. 3,000 ft., July 13, 1901.
Echo Lake,* Alt. 5,000 ft., August 12, 1901.

Alectoria jubata (L.), var. **chalybeiformis** Ach.
O'Keefe canyon, 4,000 ft., June 14, 1901.

Alectoria ochroleuca (Ehrh.) Nyl., var. **rigida** Fr.
O'Keefe canyon, Alt. 3,500 ft., June 14, 1901.

Alectoria ochroleuca (Ehrh.) Nyl. var. **sarmentosa** Nyl.
Rost Lake, Alt. 3,000 ft., July 20, 1901.
Craig Mountain, 6,150 ft., July 19, 1901.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.

Alectoria fremontii Tuckm.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.
*Missoula, Alt. 3,225 ft.

(This is commonly spoken of as "black moss." It seems to grow most luxuriantly on Douglas Spruce, Pseudotsuga mucronata (Raf.) Seed. It often trails from the limbs a foot or more. Sometimes it almost covers a small tree from top to base. Indeed, it is possible the lichen kills small trees by covering the leaves and shutting out the sun. In dense woods and damp places it grows in great abundance.)

Baeomyces aeruginosus (Scop.) DC.
Wolf Creek, Alt. 3,600 ft., July 31, 1901.
Craig Mountain, 6,700 ft., July 19, 1901.

Biatora paddensis Tuck.
O'Keefe Canyon, 4,000 ft., June 14, 1901.
Rost Lake, 3,000 ft., July 15, 1901.

Biatora decipiens (Ehrh.) Fr.
Mission range, 3,000 ft., June 29, 1901.

Biatora rufonigra Tuckm.
Silloway Mountain, 7,650 ft., June 18, 1901.

Buellia petraea (Flot. Koerb.) Tuckm. var. **montagnoei** Tuck.
* On rocks. Missoula, Alt. 3,225, Oct. 20, 1896.

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* This locality must be on the mountain side above Echo Lake. If not the altitude is incorrect, as this is almost on the same level as Rost Lake.

Buellia geographica (L.) Tuckm.
McDonald Lake, 3,800 ft., June 23, 1901.

Buellia oidalea Tuckm.
Rost Lake, 3,000 ft., July 15, 1901.

Calicium quercinum Pers.
Echo Lake, Alt. 3,000 ft., August 12, 1901.

Cetraria platyphylla Tuckm.
O'Keefe canyon, 4,000 ft., June 14, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June, 1897.
Sinyaleamin lake, 3,800 ft., June 29, 1901.

Cetraria ciliaris (Ach.) Tuck.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.

Cetraria glanca (L.) Ach.
O'Keefe Canyon, 4,000 ft., June 14, 1901.
McDonald Lake, 3,800 ft., June 22, 1901.
Mud Creek, 2,700 ft., June 28, 1901.
Swan Lake, 3,200 ft., Aug. 16, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.

Cetraria juniperina (L.) Ach.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.
Swan Lake, 3,200 ft., Aug. 16, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 27, 1897.

Cladonia amaurocraea (Fl.) Schaer.
McDonald Lake, Alt. 3,800 ft., June 24, 1901.

Cladonia caespiticia (Pers.) Fl.
Silloway Mountain, Alt. 7,750, July 18, 1901.

Cladonia cariosa (Ach.) Spreng.
McDonald Lake, Alt. 3,800 ft., June 23, 1901.

Cladonia crispata (Ach.) Flot., var. **infundibulifera** (Schaer.) Wa
McDonald Lake, Alt. 3,800 ft., June 24, 1901.

Cladonia coccifera (L.) Willd., var. **pleurota** (Flk.) Willd. Craig Mountain.

Cladonia cornuta (L.) Fr.
McDonald Lake, Alt. 3,800 ft., June 25, 1901.

Cladonia deformis (L.) Hoffm.
Sinyaleamin Lake, Alt. 3,800 ft., June 21, 1901.

Cladonia digitata (L.) Hoffm.
Flathead Lake, Alt. 2,900, July 8, 1901.

Cladonia fimbriata (L.) Fr.
* Flathead Lake, Aug., 1899.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.
On rotten wood. Abundant on decaying logs.

Cladonia fimbriata (L.) Fr., var. radiata Fr.
* Missoula, Alt. 3,225.

Cladonia fimbriata (L.) Fr., var. **tubaeformis** Fr.
Mud Creek, Alt. 3,000 ft., June 28, 1901.

Cladonia gracilis (L.) Nyl., var. **verticellata** Fr.
Sinyaleamin Lake, Alt. 3,800 ft., June 20, 1901.

Cladonia gracilis (L.) Nyl., var. **symphycarpia** Tuckm.
Sinyaleamin Lake, Alt. 3,800 ft., June 20, 1901.
McDonald Lake, Alt. 3,300 ft., June 24, 1901.
* Missoula, Alt. 3,225 ft.

Cladonia pyxidata (L.) Fr.
Stage Station, Flathead Lake, Alt. 2,960, June 28, 1901.
Bigfork, Alt. 3,000 tf., July 6, 1902.
* Flathead Lake, Alt. 3,000 ft., Aug., 1899.
* Missoula, Alt. 3,225 ft., 1899.
McDougal Lake.

Cladonia turgida (Ehrh.) Hoffm. var. **conspicua** (Schaer.) Nyl.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.

Cladonia rangifernia (L.) Hoffm., var. **sylvatica** L.
Sinyaleamin Lake, Alt. 3,800 ft., June 19, 1901.
McDonald Lake, Alt. 3,300 ft., June 24, 1901.
* Flathead Lake, Alt. 3,000 ft., Aug., 1897.

Endocarpon miniatum Ach.
Sentinel Mt., 5,000 ft., on damp rocks, June 12, 1901.

Evernia vulpina (L.) Ach.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
Sinyaleamin Lake, Alt. 3,800 ft., June 20, 1901.
* Flathead Lake, Alt. 3,000 ft., Aug., 1899.

(This beautiful yellow lichen, see plates LVIII and LXII, is very abundant, growing on dead trees and stumps, usually selecting yellow pine. Sometimes tall dead trees are covered from base to crown with this growth, presenting a beautiful sight. Not only does it grow abundant, but it becomes large. It grows in masses, sometimes many feet in length and width of a limb or trunk.)

Lecanora atra (Huds.) Ach.
Flathead Lake, Alt. 3,000 ft., July 20, 1901.
Rost Lake, Alt. 3,200 ft., July 20, 1902.

Lecanora cervina (Pers.) Nyl., var. **cinerevella** Fink.
Craig Mountain, Alt. 7,250 ft., July 19, 1901.

Lecanora pallescens (L.) Ach.
Missoula, Alt. 3,225, Oct. 20, 1899.
Growing on mosses.

Lecanora chlorophana (Wahl.) Ach.
Craig Mountain, Alt. 7,250 ft., July 19, 1901.

Lecanora punicea Ach.
Rost Lake ,Alt. 3,200 ft., June 15, 1901.

Lecanora rubina (Vill.) Ach.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
* Missoula, Oct. 20, 1899.

Lecanora subfusca (L.) Ach.
Flathead Lake, Alt. 3,000 ft., July 20, 1901.
Post Creek, 2,800 ft., June 22, 1901.

Leptogium Sp.
Undetermined because of lack of fruiting plants.
* Missoula, Alt. 3,225, 1897.

Lecanora xanthophana Nyl. var. **dealbata** Tuck.
Craig Mountain, Alt. 7,250 ft., July 19, 1901.

Parmelia conspersa (Ehrh.) Ach.
Post Creek, Alt. 2,800 ft., June 22, 1901.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.
* Missoula, Alt. 3,225, 1899.

Parmelia olivacea (L.) Ach.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
St. Ignatius, Alt. 2,800 ft., June 17, 1901.
Post Creek, Alt. 2,800 ft., June 22, 1901.

Parmelia physodes (L.) Ach.
* Lo Lo Hot Springs, Alt. 5,000, June 25, 1897.

Parmelia physodes (L.) Ach., var. **vittata** Ach.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
Sinyaleamin Lake, Alt. 4,000 ft., June 18, 1901.
* Lo Lo Hot Springs, June 25, 1897.

Parmelia physodes (L.) Ach var. **enteromorpha** Tuck.
* Lo Lo Hot Springs, Alt. 5,000, June 25, 1897.

Permelia saxatilis (L.) Fr.
Sinyaleamin Lake, Alt. 3,800 ft., June 19, 1901.
* Flathead Lake, Alt. 3,000 ft., Aug. 1, 1899.

Parmelia saxatilis (L.) Fr., var. **sulcata** Nyl.
O'Keefe Canyon, Alt. 4,000 ft., June 14, 1901.
McDonald Lake, Alt. 3,300 tf., June 25, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897

Peltigera apthosa (L.) Hoffm.
Sinyaleamin Lake, Alt. 3,800 ft., June 20, 1901.
* Missoula, Alt. 3,225, June 6, 1897.
* Lo Lo Hot Springs, Alt. 5,000, June 25, 1897.
* Flathead Lake, Alt. 3,000, Aug., 1899.

Peltigera canina (L.) Hoffm.
Sinyaleamin Lake, Alt. 3,800 ft., June 20, 1901.
O'Keefe Canyon, Alt. 3,000 ft., June 14, 1901.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.
* Flathead Lake, Alt. 3,000 ft., Aug., 1899.
* Missoula, Alt. 3,225, June 8, 1897.

Peltigera venosa (L.) Hoffm.
Bigfork, Alt. 3,000 ft., July 8, 1901.

Placodium Elegans (Link.) D. C.
McDonald Lake, Alt. 3,300 ft., June 24, 1901.
* Missoula, Alt. 3,225, Aug., 1898.

Physcia stellaris (L.) Tuckm.
St. Ignatius, Alt. 2,800 ft., June 17, 1901.

Physcia stellaris (L.) Tuckm., var. **aipolia** Nyl.
Flathead Lake, Alt. 3,000 ft., July 6, 1901.

Rinodeina oreina (Ach.) Mass.
* Missoula, Alt. 3,225, Oct. 20, 1899.
On rocks.

Ramalina calicaris (L.) Fr., var. **fastigiata** Fr.
Flathead Lake, Alt. 3,000 ft., Aug. 14, 1901.

Sticta pulmonaria (L.) Ach.
Mud Creek, Alt. 2,700 ft., June 28, 1901.
McDonald Lake, Alt. 3,300 ft., June 24, 1901.

Theloschistes Lychnens (Nyl.) T.
Bigfork, Alt. 3,000, July 6, 1901.
* Missoula, Alt. 3,225 ft., Oct. 11, 1898.

Umbilicaria hyperborea Hoffm.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.

Umbilicaria phaea Tuckm.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.

Umbilicaria vellea (L.) Nyl.
McDonald Lake, Alt. 3,300 ft., June 13, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.

(This is a beautiful species, jet black beneath, greenish brown or brown above. It covers the wet surfaces of rocks with its broad, thick thallus, often to the extent of several square yards.)

Usnea barbata (L.) Fr.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
Mud Creek, Alt. 2,700 ft., June 28, 1901.
* Flathead Lake, Alt. 3,000 ft., August, 1899.

Usnea barbata (L.) Fr., var. **hirta** Fr.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.

Usnea cavernosa Tuckm.
McDonald Lake, Alt. 3,300 ft., June 26, 1901.

List of Mosses.

Atrichum selwyni Aust.
O'Keefe Canyon, 3,000 feet, on clay, June 14, 1901.

Aulacomnium androgyniom Schwaegr.
McDonald Lake, Mission Mountains, 3,300 feet, June 23, 1901.

Amblystegium varium (Hedw.) Lindt.
Mud Creek 2,700 ft., on earth, June 28, 1901.

Campothecium aeneum Mitt.
Old Stage Station, east side Flathead Lake, 2,600 feet, on dead **Pinus ponderosa**, June 28, 1901.

Bryum bimum Schreb., same as
Ceratodon purpureus Brid.
Mud Creek, 2,700 feet, June 28, 1901.

Climacium dendroides Met. and Wohr.
McDonald Lake, 3,300 ft., on earth in swamp, June 24, 1901.

Dicranum bergeri Bland.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901.

Dicranum fragilifolium Lindt.
Mud Creek, 2,700 feet, June 28, 1901.
McDonald Lake, Mission Mountains, June 24, 1901.

Dicranum strictum Schleich.
O'Keefe Canyon, 3,000 feet, on dead wood, June 14, 1901.

Eucalypta macounii Aust.
McDonald Lake, Mission Mountains, 3,300 feet, on earth, June 25, 1901.

Euhrynchium strigosum B. & S.
McDonald Lake, Mission Mountains, 3,800 feet, June 23, 1901.

Fontinalis antipyretica L.
Mud Creek, 2,700 feet, in water, June 28, 1901.

Grimmia calyptrata Hook.
Missoula, 3,200 feet, wet rocks, June 13, 1901.

Grimmia montana B. and S.
Bigfork, 2,900 ft., on dry rocks, June 26, 1901.

Hylocomium triquetrum (L.) B. & S.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901, in cedar swamp.

Hylocomium proliferum (L.) Lindb.
McDonald Lake, Mission Mountains, 3,300 feet, in cedar swamp, June 25, 1901.

Hypnum cuspidatum L.
Mud Creek, 2,700 feet, on dead wood, June 28, 1901.

Hypnum fluitans L.
Daphni Pond, 2,700 feet, in swamp, July 5, 1901.

Hypnum giganteum Schimp.
Mud Creek, 2,700 feet, June 28, 1901.

Hypnum subimponens Lesq.
McDonald Lake, Mission Mountains, 3,300 feet, on damp rocks, June 24, 1901. Also found on earth.

Hypnum uncinatum Hedw.
McDonald Lake, 3,300 ft., on wood, June 25, 1901.

Leptobrium pyriforme Schimp.
O'Keefe Canyon, 3,000 feet, on clay, June 14, 1901.

Mnium affine Bland.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901.

Mnium insigne Mitt.
McDonald Lake, Mission Mountains, in cedar swamp, 3,300 feet June 24, 1901.

Mnium medium B. & S.
McDonald Lake, Mission Mountains, in cedar swamp, 3,300 feet, June 24, 1901.

Mnium orthorrynchum B. and S.
McDonald Lake, 3,300 feet, in cedar swamp,' June 25, 1901.

Mnium punctatum Hedw.
McDonald Lake, 3,300 ft., on damp earth, June 25, 1901.

Mnium spinulosum B. and S.
McDonald Lake, Mission Mountains, 3,300 feet, on earth, June 24, 1901.

Mnium venustum Mitt.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901.

Neckera douglasii Hook.
McDonald Lake, Mission Mountains, 3,300 feet, on wet rocks, June 25, 1901.

Orthotrichum speciosum Nels. same as
Grimmia orata Met. and Wohr.
McDonald Lake, 3,300 ft., in cedar swamp, June 24, 1901.

Orthotrichum rupestre Schleich.
McDonald Lake, 3,300 ft., on earth with lichens, June 24, 1901.

Plagiothecium elegans Schimp.
McDonald Lake, Mission Mountains, 3,300 feet, on dead wood, June 14, 1901.

Polytrichum piliferum Schrib.
O'Keefe Canyon, 3,000 feet, on clay, June 14, 1901.

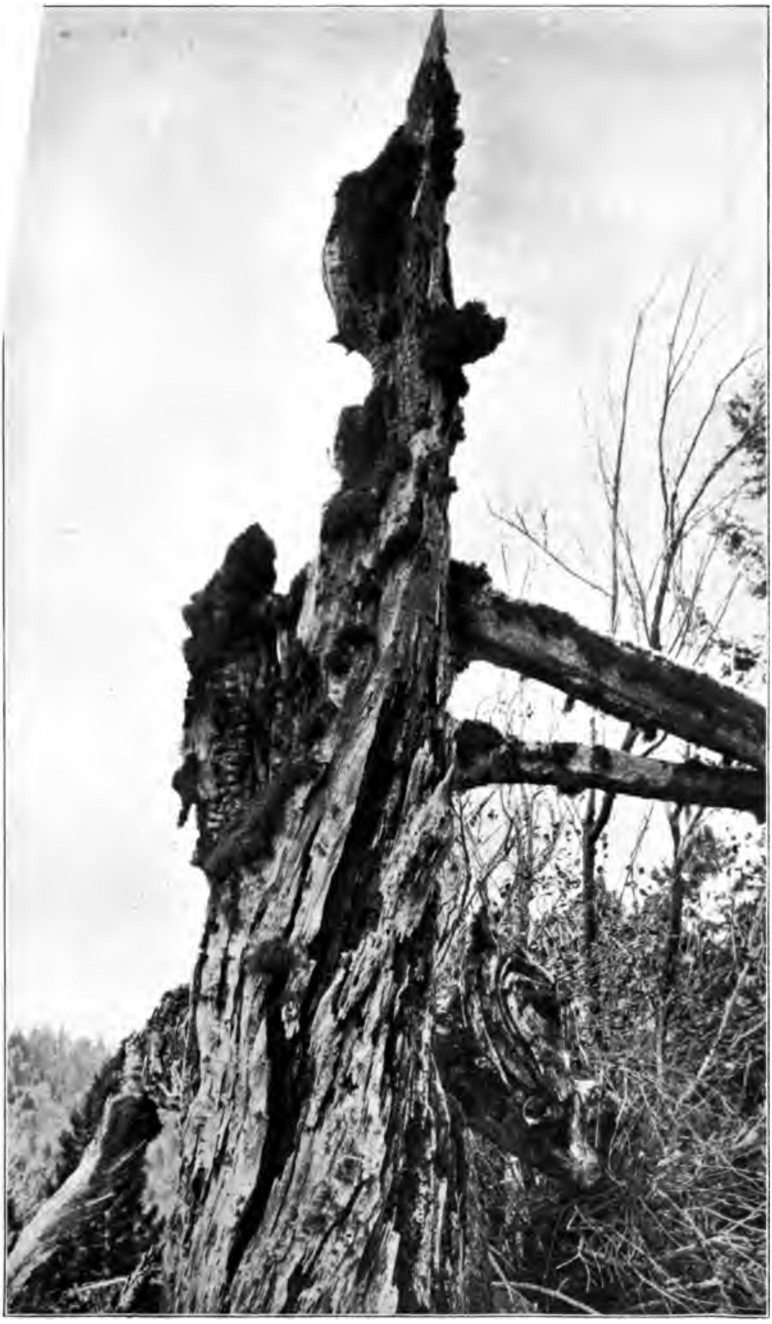
Timmia megapolitana Hedw.
McDonald Lake, 3,300 ft., June 23, 1901.
Mud Creek, 2,700 ft., June 28, 1901.

Tortula ruralis Ehrh.
O'Keefe Canyon, 3,000 feet, June 14, 1901.
McDonald Lake, Mission Mountains, 3,300 feet, in cedar swamp, June 24, 1901.

Weberа nutans Hedw.
O'Keefe Canyon, 3,000 feet, on dead wood, June 14, 1901.
Sinyaleamin Lake, 3,800 feet, on earth, June 21, 1901.

Summary

Lichens, genera 20, Species 67.
Mosses, genera 19, Species 37.
Total, genera 39, Species 104.



Evernia vulpina (L) Ach., on old stump. Mitten Mountain, Missoula, 6150.

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ASTOR, LENOX AND
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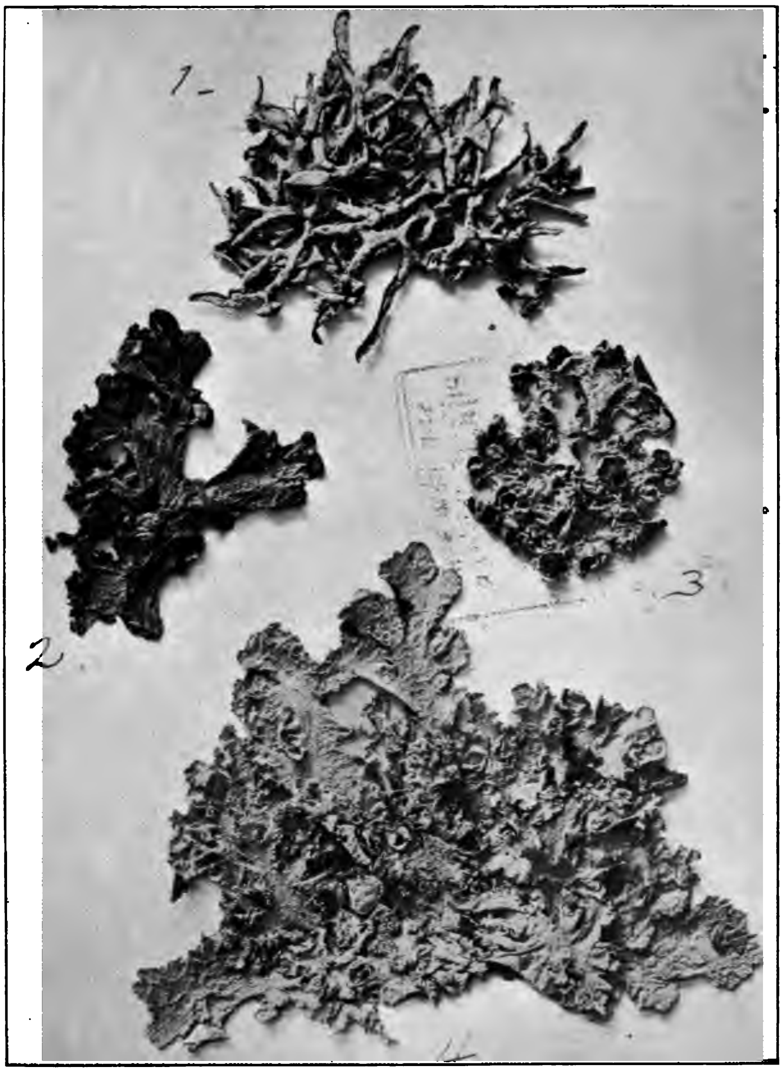
Plate I.X.



1. Parmelia physodes var vittata.
2. Cetraria platyphylla.
3. Cetraria juniperina.
4. Cetraria glanca.

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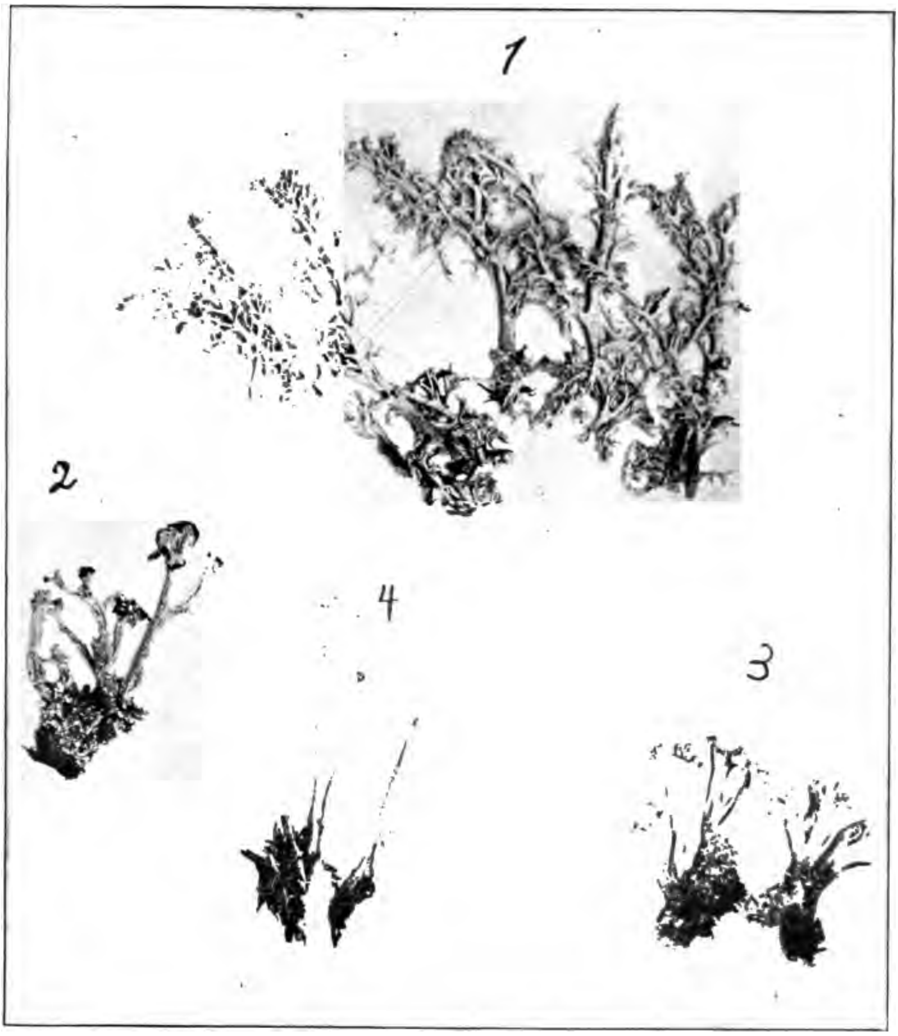

1. Cladonia rangiferina var sylvatica.
2. Cladonia cariosa.
3. Cladonia deformis.
4. Cladonia cornuta.

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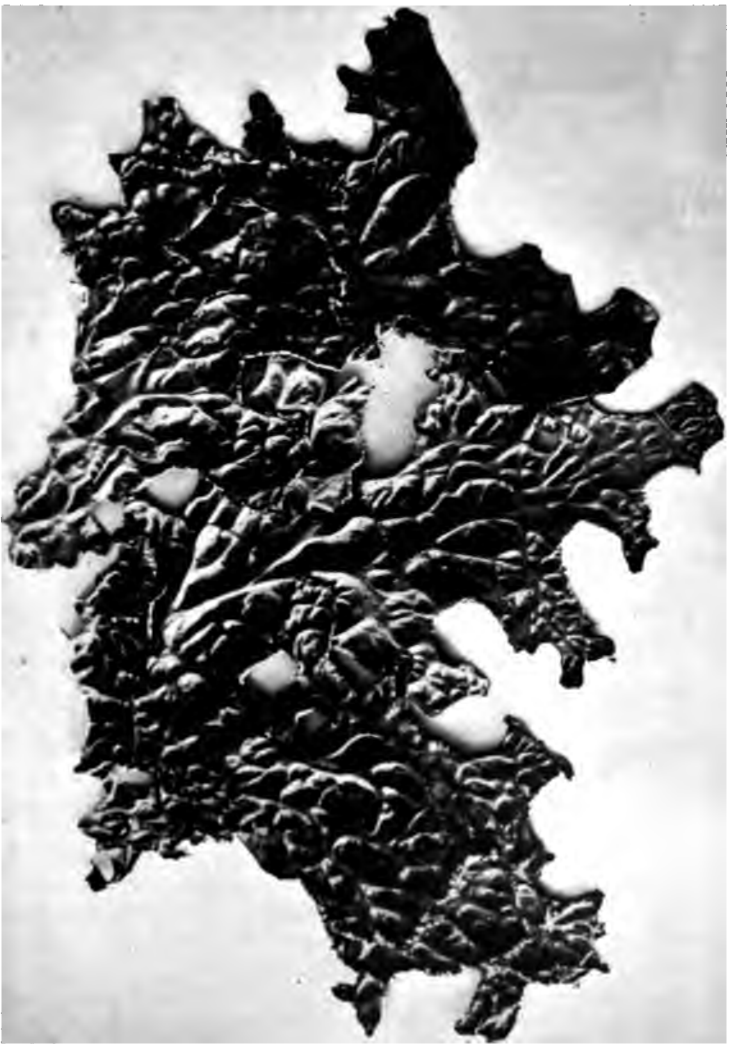

Sticta pulmonaria (L.) Ach.

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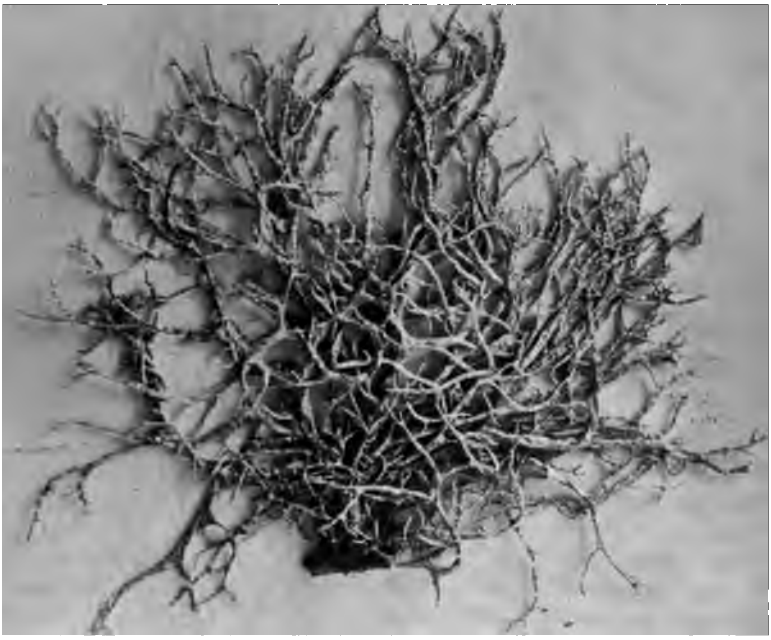

Evernia vulpina (L) Ach., one of the most common lichens in the northwest.

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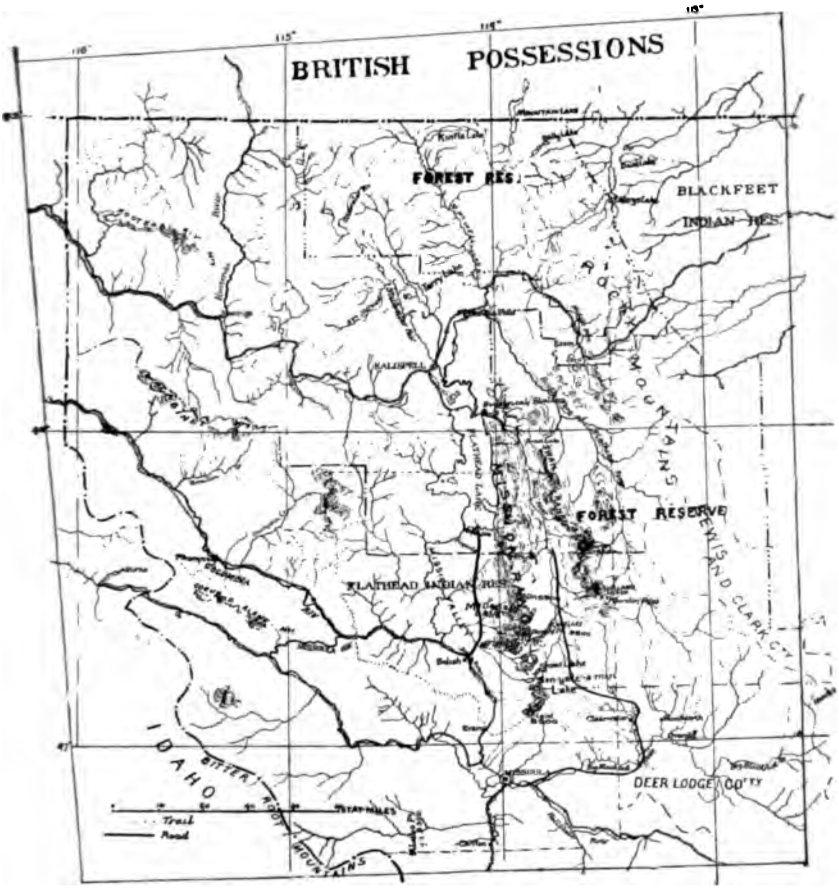

Map of Northwestern portion of Montana, showing territory covered by this report.

Bulletins of the University of Montana, Biological Series.

No. 1. Summer Birds of Flathead Lake, by P. M. Silloway. 84 pp. Plates I—XVI.

No. 2. Announcement of the Fourth Annual Session of the University of Montana Biological Station. 4 pp.

No. 3. A Biological Reconnoissance in the Vicinity of Flathead Lake, by Morton J. Elrod. Pp. 89—182, plates XVIII—XLVI, figs. 1—3.

No. 4. Announcement of the Fifth Annual Session of the University of Montana Biological Station. Pp. 183—190, 4 ills.

No. 5. Lectures Delivered at the University of Montana Biological Station during the Session of 1902. Pp. 191—288, plates XLVII—LII, figs. 4—31.

No. 6. Additional Notes to Summer Birds of Flathead Lake, by Perley Milton Silloway, with Introduction by Morton J. Elrod. Pp. 289—308, plates LIII—LVII.

No. 7. Lichens and Mosses of Montana, a list, by Wilson P. Harris and Carolyn W. Harris. Pp. 309-331. Plates LVIII—LXIV.

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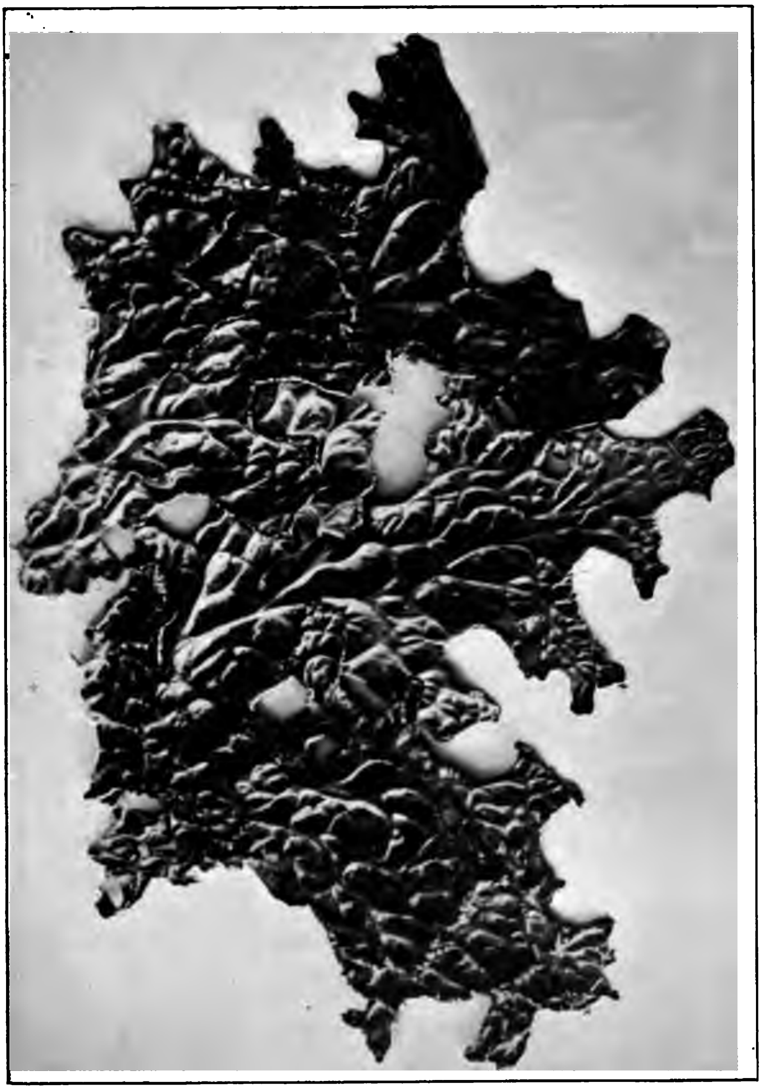

Sticta pulmonaria (L) Ach.

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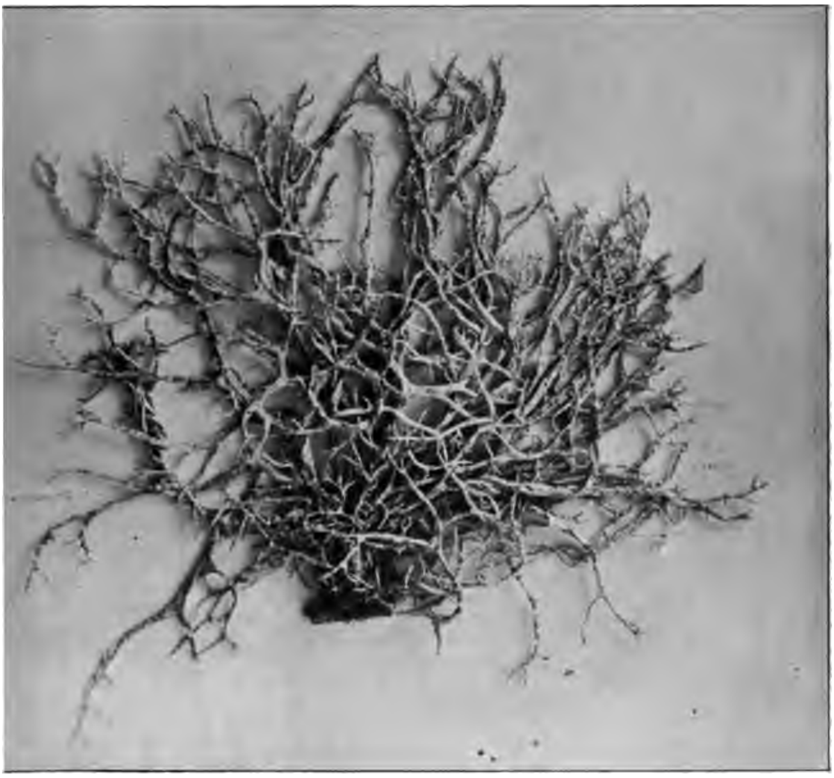

ernia vulpina (L) Ach., one of the most common lichens in the northwest.

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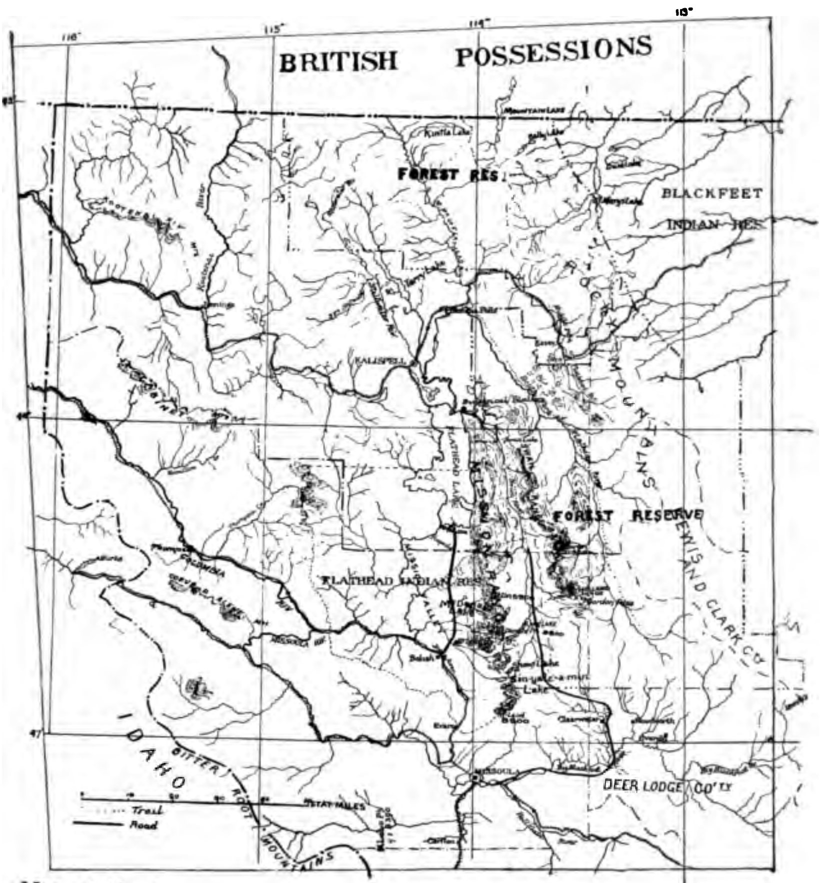
ASTOR



Map of Northwestern portion of Montana, showing territory covered by this report.

The climate is delightful. Rarely does it rain in July and August. In the shade it is always pleasant. Long trips may be planned without danger from the elements. One may sleep out without fear. In a day from the laboratory one may reach huge snow banks in middle August. There is an abundance of sunshine, no fogs nor dreary days, and few days of excessive heat.

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EQUIPMENT.

The building is a convenient out-door laboratory, with tables for a dozen students. The station work has entirely outgrown the building. Many of the lectures are given out of doors in the yard. The fine summer weather permits of much laboratory work out of doors. There is a dark room for photography. There are three boats which are the property of the station. Other boats may be had at any time. Microscopes, glassware, books and utensils will be supplied from the University. Botanical collecting and drying material will be supplied.

Fig. 46. Returning from a trip to the mountains, starting down on the trail. Photo by M. J. E.

Students in Ornithology must supply their own guns or field glasses. Necessary ammunition will be supplied at cost. Students in Photography will furnish their own cameras and plates. The necessary chemicals for development will be supplied free. Students who live in tents will supply their own tents and bedding.

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Bulletin University of Montana No 26,
Biogolical Series No. 9.

Seventh Annual Announcement

OF THE

University of Montana Biological Station

AT

FLATHEAD LAKE

BIGFORK, MONTANA.

Fig 41. Camp at Stanton Lake.

SEVENTH SESSION, JULY 12 to AUGUST 17, 1905.

Oscar J. Craig, President, University of Montana, Lecturer.

Morton J. Elrod, Professor of Biology, University of Montana, General Zoology, Entomology, Plankton.

Thomas A. Bonser, Science, Spokane High School, Botany.

Gertrude P. Norton, East Helena, Nature Study, Artist.

Entered August 24, 1901, at Missoula, Montana, as second class matter, under an Act of Congress, July 16, 1894.

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Purposes of the Station.

To serve as a field for research work in Botany, Zoology and Geology. To offer research work to candidates for a degree, such work being accepted by the University of Montana. To furnish a general course to college students, or to those preparing to teach. To make a place for high school students, where they may be permitted to work under the most favorable opportunities. To afford opportunity to teachers to collect material for class use and for their own laboratories. To provide lectures, field excursions, and laboratory exercises so as to give the best insight into the proper method of nature study. To see some of the grandest scenery in the world, and to receive the inspiration felt by those who see grand panoramas. To offer a place where healthful recreation may be had, free from care, under inspiring conditions, accompanied with an environment stimulating observation and investigation. To offer a place where kindred spirits in the state may meet and exchange ideas and by this friendly meeting receive added stimulus and enthusiasm for work.

COURSES OF STUDY.

The following scheme will give those who wish to attend an idea of the kind and character of the work that may be done.

Zoology:—

(a) General Zoology, principally field work, instructions in modes of study and observation, illustrating the influence of environment. An observational study, full of suggestion, very helpful to those who have had no such opportunity for study. Material will be collected and worked up in the laboratory.

(b) Field and laboratory course in Entomology. Instruction in collecting, preserving and labelling insects. Dissection and study of type specimens. A study of injurious insects.

(c) Ichthyology. Special course devoted particularly to the lake and river fishes and their food supply. The course will include plankton study.

(d) Ornithology. A study of birds, with methods of collecting, making and preserving skins; habits and lives of birds of the rich avian region adjacent.

Botany:—

(a) Laboratory and Field Course. Study of type forms of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, and Spermatophytes. Especial attention will be given to the Conifers of the vicinity. There will also be collecting trips in the field, where the various type forms may be found. In the laboratory, attention will be given to the classification of the more common species, to the study of Plant Morphology, to the methods of preparation of Herbarium specimens, and to the methods of preservation in liquid for immediate or permanent use.

(b) Ecology. A general course including local ecological problems, and local plant geography. This region offers quite a diversity in plant societies.

Photography:—

The region offers rare opportunities for this branch of study. The work will include a study of lenses, plates and developers. The use

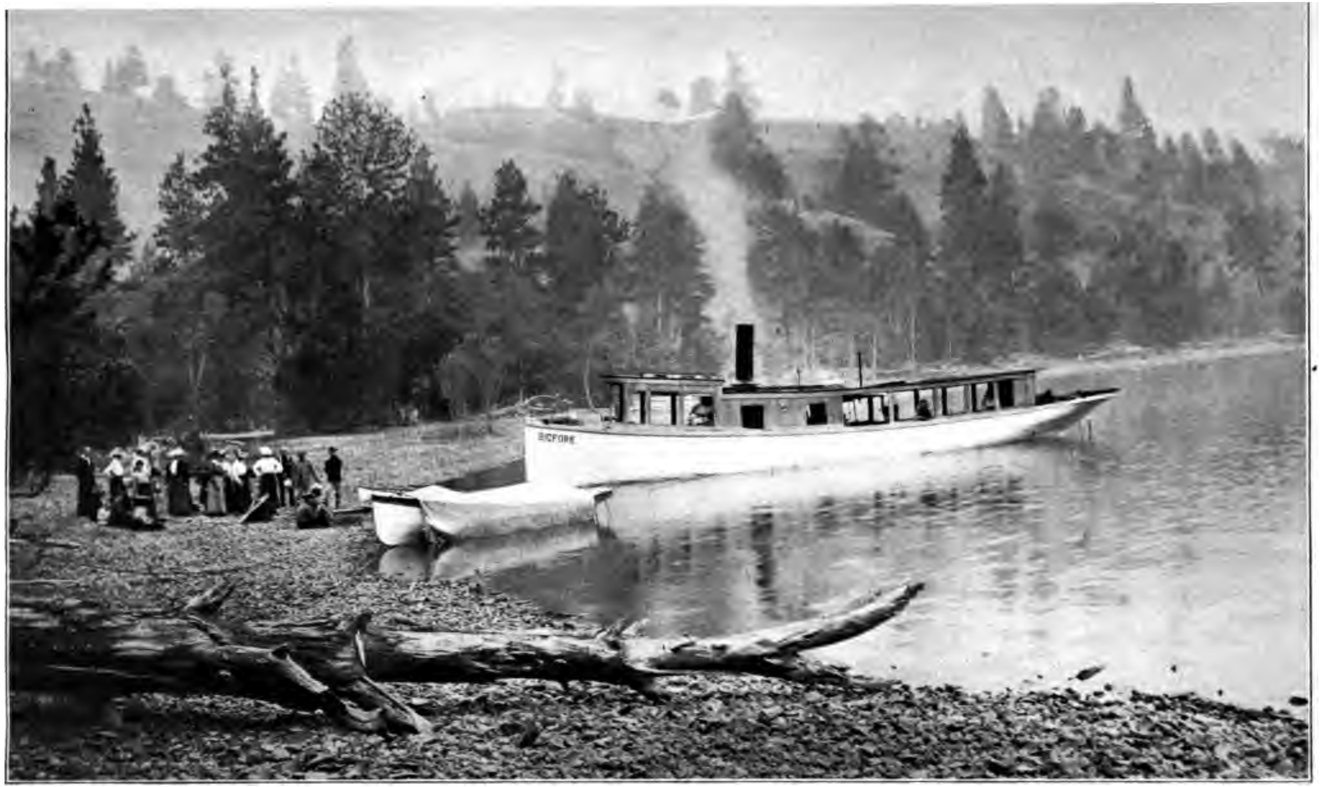

Fig. 42. An expedition of biological students, at work on Flathead Lake. Photo by M. J. E.

of the ray filter will be explained, and the many errors which may fall to the lot of the beginner will be pointed out. The course will include the selection of subject, development, printing on one or two kinds of paper, and transparencies.

Students in photography must supply their own plates or films and paper. There is a dark room at the laboratory and the scenery in the vicinity gives ample scope for a series of negatives either in landscape or of scientific subjects.

Nature Study:—

A course of study and practical work will be outlined which will afford both a fund of information on which to draw during school work and at the same time secure a collection of material to be used in illustration. The scope of the work will include zoology, botany, geology, and physiography of the region.

Physiography:—

This subject is receiving more attention than formerly. Those who desire such work will be given methods which may be used in any locality, and by excursions will be shown how to carry on observations. The course will include the surface geology, drainage, climatic conditions, and effects of vegetation.

Special Work:—

Students and investigators will be encouraged to pursue some special study, taking such problems as may be pursued with profit during the session.

It must be understood that while the daily lectures are given to all, yet each individual works alone, pursuing such study as may be best fitted to his ability and requirements. The beginner has the same opportunity as the advanced student. Realizing that study of biological subjects is not extensive in the state, preparation is made for those who have not pursued such study.

LOCATION.

The University of Montana Biological Station was opened in 1899. For the past six summers the station has been occupied from June until September or October. During this time some twelve states have been represented. The Station has become well known to many American naturalists, and all are enthusiastic in their praise of opportunities afforded in the vicinity of Montana's large inland lake.

For scenery the vicinity cannot be surpassed. Few places offer more varied points of interest. The roaring rapids of Swan river are at the door of the building. Flathead lake, covering more than 300 square miles of territory, with its beautiful islands and precipitous shores, has great attractions. The Mission range, beginning on the burnt hills by the laboratory, and rising higher and higher as they extend southward, culminate in snow capped peaks 10,000 feet in height. A few miles to the east is the Swan range, its high summits constantly in view. These two mountain ranges afford some of the most beautiful panoramas to be seen in the Rocky Mountains, and rival the Alps in magnificent scenery. Farther to the east, reached in a short time by pack train, the main chain of the Rocky Mountains breaks the horizon with lofty peaks and precipitous summits. Untrod summits invite the courageous naturalist who seeks the unknown animal and vegetable life. West of Flathead lake are the almost unexplored Cabinets. Within a few miles are many lakes—Swan, Echo, Rost, and others—while many ponds and swamps are in the immediate vicinity. The waters of Swan and Flathead rivers supply Flathead lake, the former at the laboratory door, the latter but two miles distant. East and south of the laboratory the forests extend

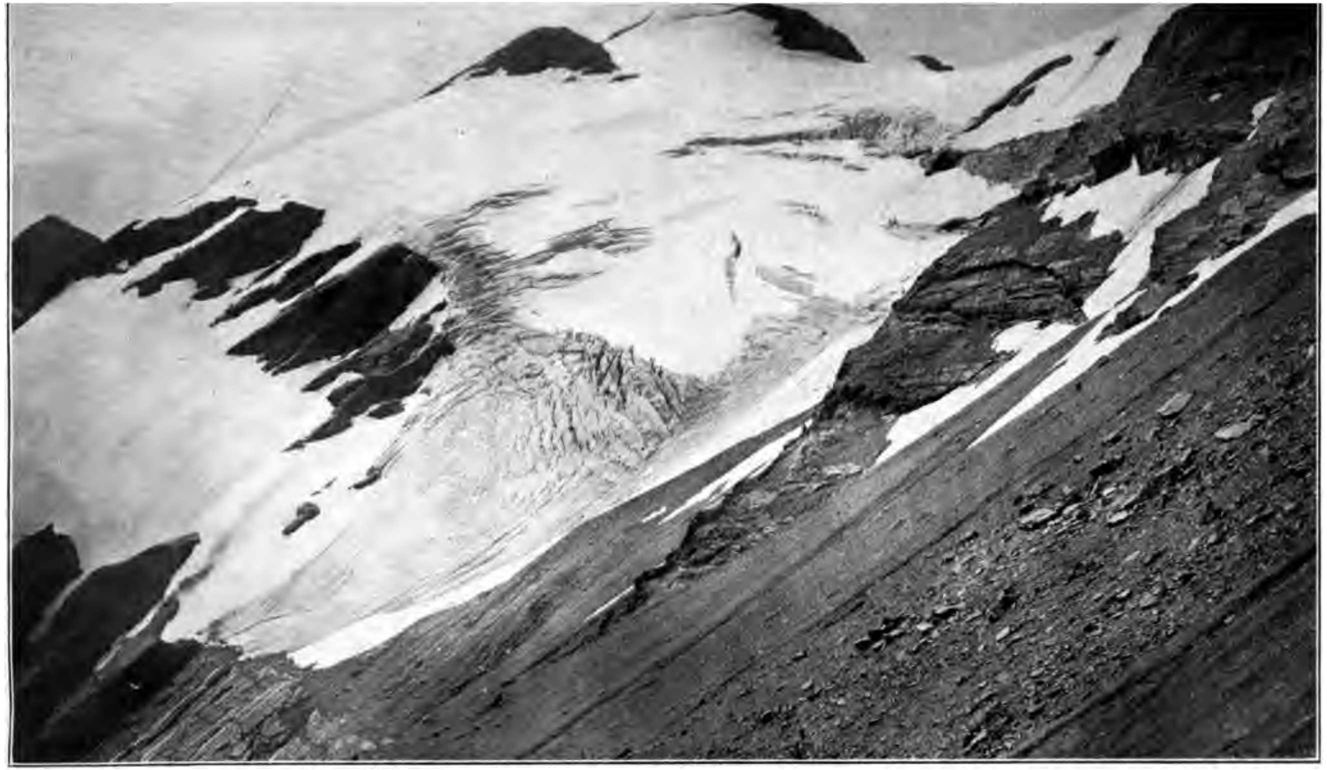

Fig. 43. A hanging glacier on G. N., in late August. Characteristic mountainous country which may be reached, and where rare species may be had. Photo by M. J. E.

unbroken for a hundred miles, with here and there a settler's cabin. Such a combination of lakes, rivers, mountains, forests, at elevations from 3,000 to 10,000 feet, one will find in few places in America.

The present site of the Station was chosen because of the advantages mentioned above. The seaside will always have its attractions and its devotees. But there are those who love the mountains, who delight in craggy heights, and who find abundance of material for study because it is new and the field unexplored. There are many who cannot take long trips to the sea shore, others who wish to spend a summer on the inland lakes, in the primeval forest, and among the snow-clad hills. Then there is the home field. Montana needs a wider dissemination of knowledge of outdoor study. Here may be had healthful recreation, beautiful surroundings, congenial associates, and rare opportunities for observation and study.

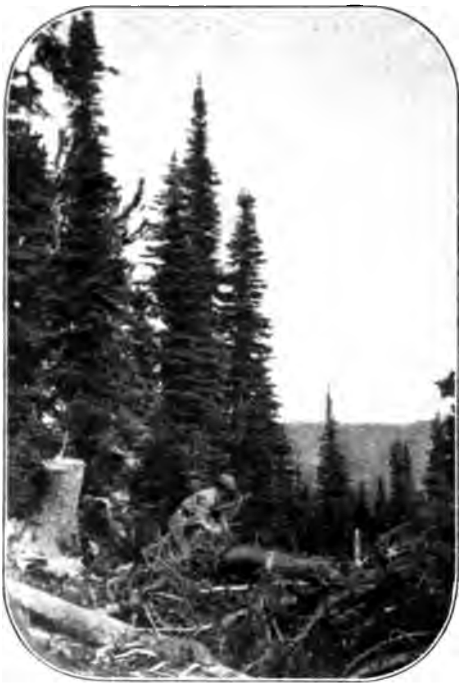

Fig. 44. Collecting samples of Alpine Fir for the University Museum. Photo by M. J. E.

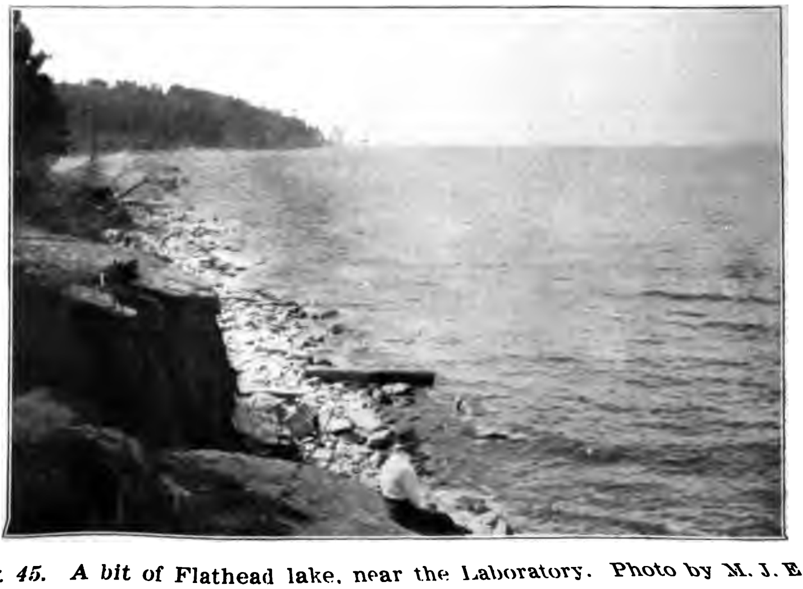

Fig. 45. A bit of Flathead lake, near the Laboratory. Photo by M. J. E.

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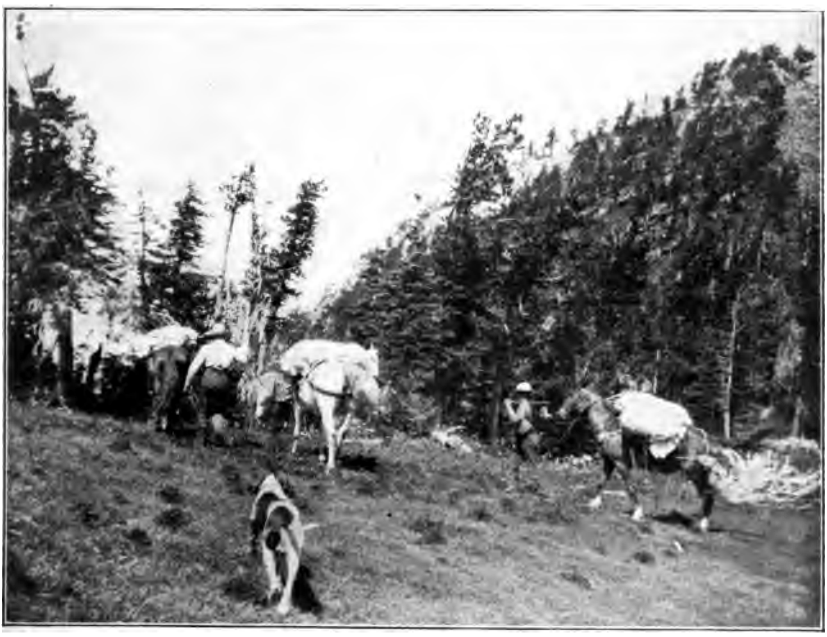

Fig. 46. Returning from a trip to the mountains, starting down on the trail. Photo by M. J. E.

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UNIVERSITY CREDITS.

Students from the University may pursue study at the Station and receive credit for such work as may be equivalent to University courses. Students taking elementary study may receive preparatory credits.

METHODS OF INSTRUCTION.

The work will consist very largely of field collecting and observation, study of relation to environment, supplemented by laboratory dissections and miscroscopic examination. The general courses will enable teachers to familiarize themselves with methods of field work, and give a store of information from which to draw in nature study subjects. The general courses also give opportunity to students and others to pursue lines of study with better facilities for out door work with fresh material, than is generally to be had in regular university work.

The expeditions are primarily to give opportunity for the study of animals and plants in their natural environment. By this means more lasting interest is aroused, and more accurate information is obtained.

LECTURES.

Almost every day a lecture on some biological topic will be given at the laboratory. Some of the lectures given in 1902 have been incorporated in Bulletin University of Montana, Biological Series No. 5. Thirteen lectures, covering 90 pages, with 5 plates and 27 figures, are included.

The following lectures will be given during the coming session:
Instinct and Intelligence in Animals.
The Debt of Science to Lewis and Clark, with Stereopticon.
The Forests of Flathead Valley.
The Geology and Natural History of Flathead Lake.
Montana's Agricultural Water Supply, with Stereopticon.
Studies in Alpine Life, with Stereopticon.
The Mosquito Problem.
The Place of Field Work in Scientific Study.
The Mission Mountains, with Stereopticon.
Evolution of Plant Forms, with Stereopticon.
Evolution of Plant Reproduction, with Stereopticon.
Elementary Forestry.
Plant Societies of the Northwest.
The Coniferae.
Seed Dispersal.
The Ancient History of America.
Nature study for the Grades.
Nature Reproduced in Art.

EXCURSIONS.

The following excursions will be taken during the session of 1905, unless the weather is unfavorable:

1. A trip to Swan Lake, through the forests, with stop over night at the lake. This is a beautiful lake in the mountains, of great interest biologically and geologically.
2. A trip to Rost Lake, at the base of the Kootenay Mountains. This is a lake almost filled up, a fine collecting field. It is an admirable location for camps.
3. An ascent of MacDougal Peak via an Indian trail, to an altitude of 7,725 feet. This will afford opportunity for alpine collecting, and will present some of the most sublime scenery in the world.
4. A trip around Flathead Lake, making study of its banks, bays, and swamps.

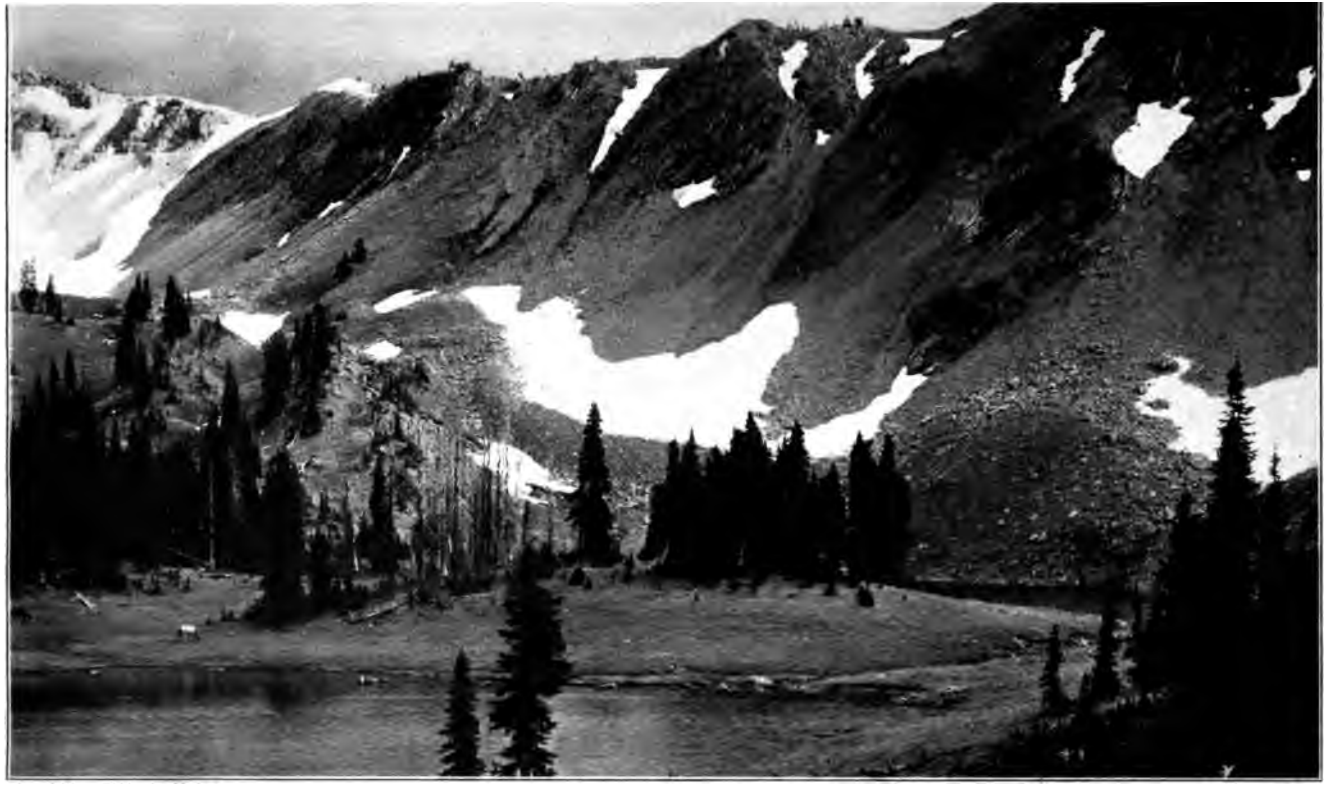

Fig. 47. Alpine region in the Swan Range, visited annually for the collection of Alpine species. Photo in August by M. J. E.

These trips will be under the personal supervision of the Director of the Station. Those taking the trips must bear a proportionate share of the expense necessary. Such trips will prove of great value and interest biologically aside from the pleasures they bring. These trips are not for mere pleasure, but for scientific study. Daily conferences are held to report on observations and to make suggestions.

HOW TO REACH THE STATION.

Students via Northern Pacific will get off at Selish. Stage tri-weekly runs to Flathead Lake (35 miles), connecting with steamer Klondyke, which runs across the lake. Stage fare, one way, $3.00, round trip, $5.00, trunks extra. Boat fare across the lake, one way, $3.00, round trip, $5.00. Stage leaves Selish on Mondays, Wednesdays and Fridays, connecting with the steamer, returning the same day. A daily stage, carrying mail and passengers, runs from Selish to Polson via Mission and Ronan. Passengers may thus travel to Polson daily. Both stages start from Selish, reaching Polson by different routes. They are under different managements.

Students via Great Northern will get off at Kalispell, connecting by stage with the steamer Klondyke at Demersville, a short distance from Kalispell.

Fig. 48. A Portion of Echo Lake, Near the Laboratory. Photo by Ricker.

DATE OF OPENING.

The laboratory work of the Station will begin Wednesday, July 12, and continue five weeks, or until Thursday, August 27. For a week or more before the Station opens some one of the staff will be at or near the Station, and will aid any who may choose to work during such time. The laboratory is at the disposal of students from June 15 to September 1, or even later, if any wish to use it.

BOARD AND ROOM.

Most of those at the Station, including the staff, live in tents. A few tents are for rent. Day board may be had at $4.50 to $5.00 per week. Board and room may be had at $7.00 per week. Many prefer to do their own cooking. The stores supply all the necessaries of life, while the region affords an abundance of fruit and vegetables. Daily mail gives easy communication with the outside world. There is also telephone connection.

RECREATION.

Change is rest. To take a day off and go a fishing often gives new lease of life. The tingle of the nerves when the gamey fish tugs at the line is to forget care and to be thoroughly alive. Many will wish to combine an outing with study. In fact, one of the attractions of the place is its natural advantages so as to induce out-door exercise and study. The lake and rivers make rowing a good pastime. The photographer has a field of wondrous richness and varied interest. A fine sand beach makes bathing a delight, and it is indulged in. Unless the lake is stirred by winds the water is warm. The hills and forests afford quiet retreats for study or strolls. The hills and roads give glimpses of scenery of rare beauty. At the proper season hunting is good. Deer have been seen annually a few rods from the laboratory. Grouse and pheasants abound in the hills. In season duck shooting is fine. A day's tramp will take one to the home of the Rocky Mountain goat. In a day one may penetrate a pathless forest or stand on craggy heights, where the view presents the jagged Rockies, the bockbone of the continent.

PUBLICATIONS.

Articles from persons who have attended the station or taken part in its work have appeared from time to time in such magazines and periodicals as The Journal of Applied Microscopy, The Nautilus, Science, The Condor, The Botanical Gazette, Journal of the New York Botanical Garden, etc. The bulletins issued by the University as a result of the work are: No. 1, "Summer Birds of Flathead Lake," P. M. Silloway, 84 pp., 16 plates; No. 2, Announcement of the Fourth Annual Session; No. 3, "A Biological Reconnaissance in the Vicinity of Flathead Lake," M. J. Elrod, 94 pp., 29 plates; No. 4, Announcement of the Fifth Annual Session; No. 5, "Lectures Delivered at the Station," 78 pp., 6 plates, 28 figures; No. 6, "Additional Notes to Summer Birds of Flathead Lake," P. M. Silloway, 32 pp., 5 plates; No. 7, "Lichens and Mosses of Montana," W. P. Harris and Carolyn W. Harris, 24 pp., 9 plates: No. 8, Sixth Annual Announcement. These bulletins are sent on request, accompanied by postage, so long as they last. Other publication are ready for the press. No. 10, "The Butterflies of Montana," is in the press.

LIFE AT THE STATION.

Conventional clothing is discarded. There is a freedom of living which makes life pleasant for those attending. Outdoor clothing is worn by all. A canvas suit with plenty of pockets is suitable for men, with a business suit for occasions. For mountain trips a suit of woolen underwear is desirable, and a sweater will come handy. For tramps in the woods, climbing mountains, or walking the rocky beach, a pair of heavy soled and hob-nailed shoes are a necessity. A suitable station suit for women consists of a short skirt over bloomers, waists, jacket, or cape, felt hat or tam o'shanter, a pair of heavy soled shoes with hob-nails, with woolen underwear for mountain trips. As most of the Station work is out of doors and of the rough and ready nature, good clothes are an encumbrance. The freedom from conventional dress makes Station life more helpful and desirable. Plenty of pockets and freedom of movement are the essentials to do successful work. The baggage may therefore be reduced to small amount. As bathing is good a bathing suit will serve for this purpose and water collecting.

BAGGAGE.

Avoid trunks. Pack outfits in rolls, covered by canvas, fastened by large and strong straps or ropes. Hand baggage of any kind is not troublesome. Heavy weight of books is unnecessary. For those who [illegible] prefer to do, a tent is necessary. This [illegible] for ordinary miner's or wall tents poles are [illegible] cut after arrival.

[illegible] must remember the nights are always cool. [illegible] and two comforts or heavy blankets over, [illegible] the individual, are necessary. These can [illegible] this is desired, and at reasonable rate. [illegible] sleeping bag is a luxury.

[illegible] minimum in weight. Heavy weight of books [illegible] matter for leisure moments should be [illegible]

[illegible] address.

MORTON J. ELROD, Director,
Missoula, Montana.

[illegible] the University, its departments, courses [illegible]

OSCAR J. CRAIG, President,
Missoula, Montana.

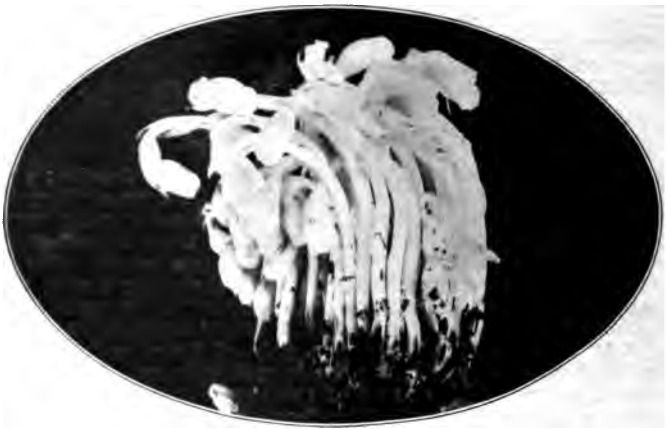

Fig. 50. A Bunch of Indian Pipe, Monotropa Uniflora.
Photo by M. J. E.

UNIVERSITY OF MONTANA

BULLETIN No. 30

BIOLOGICAL SERIES No. 10

The Butterflies of Montana

With Keys for Determination of Species

by

Morton John Elrod, Ph.D.,

Professor of Biology, University of Montana, Director of
University of Montana Biological Station,

ASSISTED BY FRANCES INEZ MALEY, A.B.

A Nature Study Bulletin, for the use of Teachers, Students and others who wish to study the Butterflies; with one colored plate, twelve plates in black and white, and one hundred and twenty-five figures.

UNIVERSITY OF MONTANA,
Missoula, Montana, U. S. A.
January, 1906.

Entered August 24, 1901, at Missoula, Montana, as second class matter, under act of Congress July 16, 1894.

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The University of Montana.

TO THE BOYS AND GIRLS OF MONTANA, WHO DELIGHT IN ROAMING THE HILLS OR IN FOLLOWING THE BANKS OF THE STREAMS.

EXPLANATION OF PLATE I.

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Fig. 2. Upper surface of **Lemonias chalcedon,** Doubleday and Hewitson.

Fig. 3. Upper surface of **Phyciodes mylitta,** Edwards.

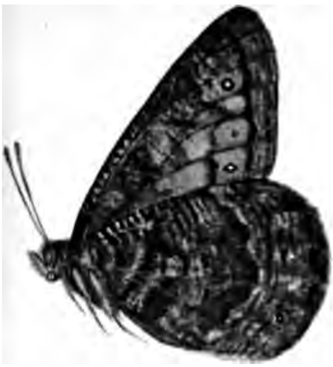
Fig. 4. Upper surface of male **Chalceria rubidus,** Edwards.

Fig. 6. Lower surface of **Cercyonis sylvestris,** var **charon,** Edwards.

Fig. 6. Lower surface of **Thecla acadica,** Edwards.

From water color drawings by Mrs. Edith Ricker.

All figures enlarged about one-third.



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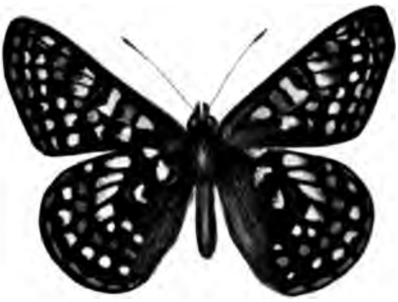

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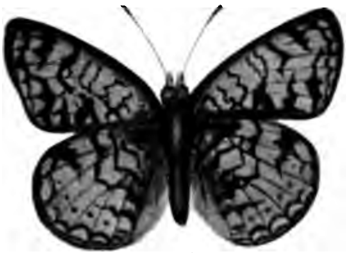

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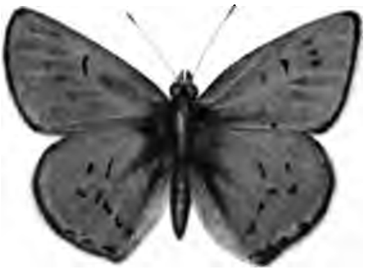

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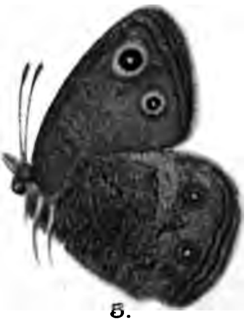

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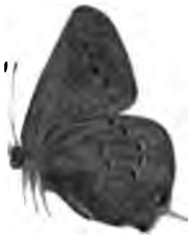

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ASTOR, LENOX AND
TILDEN FOUNDATIONS

Preface.

In preparing some Nature Study work for teachers it became apparent that teachers have little to work on in this region to enable them to prepare studies on butterflies. It was really to assist teachers and others in identifying specimens that this bulletin was prepared. It is hoped that it will meet the needs of teachers and be of material assistance to them. The boys and girls of the state have little to assist them in the study of natural history specimens of the state, since the books which would be serviceable are either too expensice or too volumnious to handle. If the study of the butterflies is stimulated in the coming generation the writer will feel amply repaid.

Full credit for most of the assistance rendered has been given in the Introduction. Mrs. C. A. Wiley, of Miles City, has very kindly placed at our disposal a copy of Edwards' Butterflies of North America, with colored plates. Supt. P. M. Silloway of Lewistown, has rendered material aid in collecting specimens at Swan lake. The glossary has been prepared by Josiah J. Moore, of Anaconda, a student at the University of Montana. The index nas largely been prepared by my wife.

I offer no apology for making some of the descriptions much longer than others. Some of these are totally inaccessible to hundreds of those who will use this work. A lengthy description of a species that will be difficult of determination will be of great service to the young student. Where the specific characters are easy of determination and good photographs are supplied the descriptions are brief.

After the matter was all in type a list of butterflies was received from Prof. Ezra Allen, of the State Normal at Dillon, which specimens have been incorporated in the work. The information in this bulletin includes reference to specimens collected in the eastern end of the state at Miles City, the central portion at Bozeman, the southern part at Aldridge and Dillon, the main Rocky Mountain region at Helena, the western slope at Missoula and Flathead Lake.

Nov. 1, 1905. M. J. E.

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The Butterfly.

I hold you at last in my hand,
  Exquisite child of the air;
Can I ever understand
  How you grew to be so fair?

You came to this linden tree
  To taste its delicious sweet,
I sitting here in the shadow and shine
  Playing around its feet.

Now I hold you fast in my hand,
  You marvelous butterfly
Till you help me to understand
  The eternal mystery.

From that creeping thing in the dust
  To this shining bliss in the blue!
God, give me courage to trust
  I can break my chrysalis too!

—Alice Freeman Palmer.

Introduction.

The present bulletin is the result of eight years of collecting and tabulating material. My first butterflies captured in the state were taken at Miles City in the east and Mount Lo Lo in the west during a recreation trip in August, 1892. In 1897 I came to the state to live. Every summer since then to the present time has been spent in the field, and the accumulated insects have been arranged at the University of Montana, where they have been worked over at leisure moments.

In the fall of 1900 Miss Frances Inez Maley was given the task of spreading, arranging and labeling the material, identifying it so far as possible with the specimens and literature at command. A large portion of her time for that school year was devoted to the work. The collection of more than a thousand specimens was spread and arranged in Comstock cases. A large number of the photographs were taken at that time, others later. Many of the keys and descriptions were prepared by her, and the results of her careful and painstaking labor were submitted to the faculty as her graduating thesis for the degree B. A. in June, 1901.

As it was impossible then to correct and verify as must necessarily be done before printing, it was decided to test the keys and make further addition to the list by including references to all the collections available in the state. For several summers the keys have been in the hands of many persons both at the University in regular work and at the University of Montana Biological Station at Flathead lake. In this way many errors have been avoided, and the keys have been found to be serviceable in the hands of beginners. Moreover, by the examniation of other collections many additions were made, necessitating changes in the keys and in the text. Many of the discriptions were rewritten.

To avoid confusion it was decided to follow the nomenclature used by Dyar and others in Bulletin 52, United States National Museum. In this bulletin many species recorded in other publications are reduced to synonyms or varieties of other species. After examining so many hundreds of specimens from various parts of the state, at different altitudes, I feel convinced that the list can be reduced still further without detriment, and without sacrificing. To cite a single illustration. The Wiley collection has specimens of **Argynnis** from Miles City, collected in 1893, and identified by Edwards as **A. edwardsi.** Epecimens from Miles City sent by myself to Edwards in 1892 were labeled **A. nevadensis.** When placed side by side they look exactly alike, and are undoubtedly of the same species.

Owing to the varying conditions as to heat and cold, moisture and sunshine, which prevail in the state, many species are subject to great variation. This makes identification oftentimes difficult, and we have often been greatly puzzled. As a result of these great variations, combined with the mistakes one is likely to make in undertaking a task like this so far from library centers and large collections, we feel that we have certainly made many errors, of which we are now not aware. We have at least brought together the material in the state and have brought it into some kind of order for students of butterflies later to make more perfect. The task has been all the more difficult because the state contains specimens from the Great Plains region, from the Pacific coast region, and from the Boreal fauna in the north.

The collections examined and recorded in this bulletin are the following: (1) The collection made by the writer, almost entirely in the museum of the University of Montana, made during the past eight seasons of collecting. These have been taken mostly in the western end of the state. The numbers of specimens in the collection has not been determined, but there are many thousand. (2) George E. Barnes, a graduate of the University, made a collection of several hundred in the vicinity of Aldridge, in the southern part of the state near the Park. These were generously donated by him to the University. (3) E. N. Brandegee, of Helena, made a collection of several hundred specimens in the vicinity of Helena in 1902. These he very kindly placed at the disposal of the writer for examination and study. (4) The late C. A. Wiley, of Miles City, made an extensive collection of Lepidoptera in eastern Montana during his several years of residence in Montana. This collection came to the University entire, and has been gone over carefully. (5) The collection at the Montana College of Agriculture and Mechanic Arts at Bozeman, the work of Professor R. A. Cooley, was very kindly placed at my disposal by Prof. Cooley. This contains a good series of insects, excellently mounted, and in some cases from high altitudes. Eugene Coubeaux, of Big Sandy, made a collection during the summers of 1904 and 1905, and very kindly loaned specimens for examination. He also furtnished notes regarding the abundance of each species. These five collections practically represent the butterfly collections in the state. They contain specimens from the extreme east and west, and from the south. The great section of country tributary to the Missouri river in the northeast is not represented, nor is the extreme north in the Rocky Mountains. Other authors have been referred to and quoted freely.

The illustrations are almost entirely original. The colored plate is the result of the work of Mrs. Edith Ricker, of Burlington, Iowa, who has spent three summers at the Station at Flathead. Colored drawings were made from specimens and the colored drawings were made into the printed plate by the three color process. It is to be regretted that the expense precluded more generous use of colored plates, instead of the half tones. Many of the drawings were also made by Mrs. Ricker and her brother, Lisle W. Brown, now in connection with the Eastman Kodak Company, including all of the figures of wing venation, except a few made by Claude Spaulding, laboratory assistant at the University. The photographs of butterflies were made by Miss Maley, Mr. Spaulding and the writer. Other photographs used have appropriate credit given with each.

Without the generous aid of these friends, who gave their work cheerfully and gratuitously, these original illustrations would be lacking.

We are deeply indebted to President Craig, of the University, for the cordial support he has given us in our efforts to popularize this subject and make the study available to the younger generation of the state. His liberal policy has enabled us to use copious illustrations, and any plan for better results or for increased usefulness of publications has always met with his hearty favor.

The pleasure we have found in the preparation of the material for publication has been ample compensation for the labor. We can wish for those who peruse it or read it no more enjoyment in its use than has been ours in gathering the specimens and bringing them together. Every specimen which we have gathered recalls some scene, whether it be the jagged sky line of the back bone of the continent as viewed from the Swan range when we were sweeping in a few **Phyciodes,** a battered **Eurymus alexandra,** or the various species of **Argynnids,** or the quiet and peaceful woods adjacent to the laboratory at Flathead lake. Again, as we pick up **Satyrus olympus** or **Brenthis myrina** we are reminded of the dusky faces on the Flathead reservation and the beautiful Mission valley, flanked by the majestic Mission mountains. **Vanessa californica** brings to us in winter the first breath of spring, as it is our earliest specimen, coming at Missoula in 1903, February 19. **Vanessa J. album** carries us to Swan lake, where the manical call of the loon is answered by the blood curdling shrief of the puma, while the water lap-laps the bottom of our boat as we head for the campfire on shore.

Beautiful, dainty, golden laced **Lycana melissa** carries us to Sinyaleamin lake, cradled in the mountains, where we spent such happy and care free days. **Oeneas chryxus** takes our memory to Mount Woody, south of Missoula, which we have ascended a dozen times for butterflies. Whichever way we turn, whatever insect we pick up, our memory brings to us days of happiness and pleasure.

M. J. ELROD,
University of Montana.

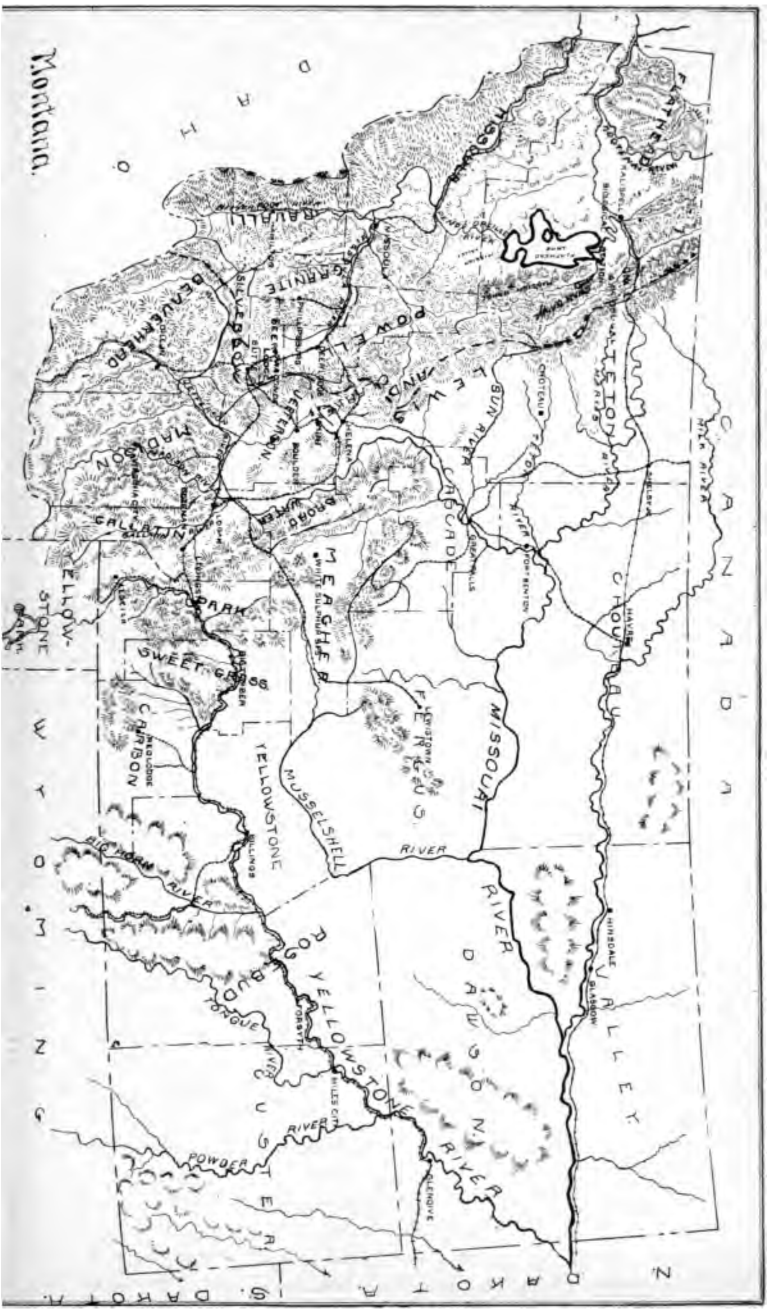
Montana.

Montana lies between the parallels of 49 degrees and 44 degrees 15 minutes north latitude, and extends from 104 degrees to 116 degrees west longitude. The form of the state is nearly a parallelogram, being about 540 miles in length with an average width of 275 miles.

The surface of the state is generally mountainous. The main range of the Rocky mountains, with numerous spurs, traverses the western part in a direction northwest to southeast; between these are many beautiful and extensive valleys, which cover nearly three-fourths of its area. The northeastern fourth is a high, rolling prairie country, covered with nutritious grasses. A considerable portion of the country between the Missouri and Yellowstone rivers is occupied by the Mauvaises Terres.

The average elevation of the surface is about 4,000 feet above the level of the sea. The elevation of the eastern third of the state is less than 3,000 feet, while that of the mountains and foothills in the western part of the state is from 4,000 to 10,000 feet. The highest peak is above 12,000 feet. The surface rises westward at the rate of about eight feet per mile.

This state has extremes of climate. Many sections of the state experience severe northern blizzards, others have delightful summers, still others hot deserts. Lovely lakes lie in the north, dry treeless plains in the east, almost devoid of vegetation. The western slopes with their copious rainfall afford a climate moist and warm. To the south are mountains capped with snow. Between these are many grand canyons.



ap of Montana, showing geographical areas, and localities where col-
ions have been made.

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ASTOR, LENOX AND
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Collecting and Preserving Specimens.

In collecting butterflies a net is necessary, and some means of killing them after capture.

The simplest form of the net, which can be made almost anywhere, is constructed as follows: A rod of some light stiff material is used as the handle, not more than five feet in length. Attached to this at its upper end is a loop or ring made of metal or some moderately stiff yet flexible material. Upon this then should be sewed a bag of fine netting, preferably tarlatan, almost thirty inches deep; the ring should be not less than a foot in diameter.

Several forms of folding nets are on the market by dealers in entomological supplies. These nets are detachable from the handle, and will fold in two or more pieces. They may thus be tucked in a pocket or packed in with baggage without injury, to be drawn out and speedily adjusted when necessary. Handles may also be purchased which fit together in sections, and are likewise easily transported and quickly adjusted. See Fig. 1.

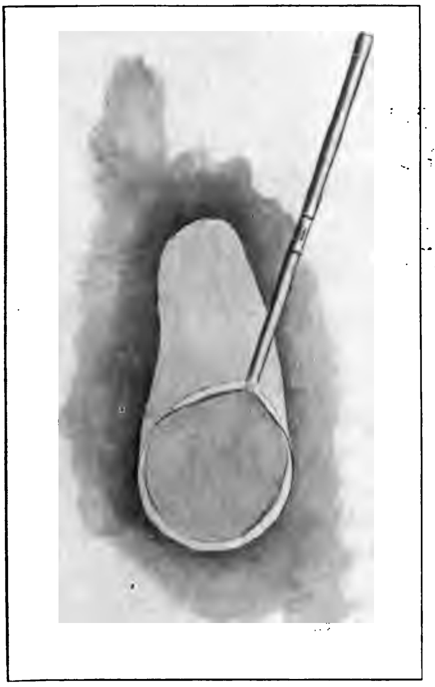

Fig. 1. A butterfly net.

Nets may be purchased with silk bags if desired. A silk bag has many advantages. It dries readily when wet, requiring but a few swishes through the air. It may be swept through the air with much greater speed than any other net. It does not snag readily, and has a much longer life.

The specimens collected are killed in some way that shall not mutilate them. A very convenient way is by means of the cyanide bottle, which is prepared in the following manner: Take a wide mouthed bottle holding four or six ounces. Put in the bottle a piece of cyanide of potassium about three-fourths of an inch square or a table spoonful of the pulverized, and water enough to cover the cyanide and then, immediately before there is time for the cyanide to dissolve, put enough plaster of Paris in the bottle to soak up the water. Cut a paper as in Fig. 2 to cover the plaster. The bottle should then be left open in a shady place for an hour to dry and then securely corked and labeled "Poison." See Fig. 3.

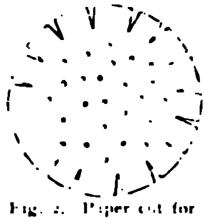

Fig. 2. Paper cut for cyanide bottle.

Specimens placed in the bottle to be killed should be left there for at least a half hour, but they may be left in over night without injury.

Another method of killing the insect is to enclose a piece of cotton, upon which a few drops of chloroform, salphuric ether or benzene has been put, with the insect to be killed, in a small bottle or small box.

Still another method of killing is to entangle the insect in the meshes of the (silk) net, with wings over the back, and give a quick but hard squeeze on the sides of the thorax. This may do some injury to the insect by rubbing off some scales, but in the absence of a killing bottle it may be necessary to kill a specimen or lose it.

Much of the success of the collector will depend upon his skill in the use of his net. No description of the method is worth anything besides a very little experience, and one soon learns to capture with dextrous turn of the hand, "practice makes perfect." It is possible to sweep into the net an insect which is fluttering through the air and by a turn of the hand to close the bag. One manner which is preferred by many is to clap the net over the butterfly and allow it to rise, and then insert the bottle in the net and without touching it allow it to drop into the bottle. If possible the fingers should never be allowed to come in contact with the wings.

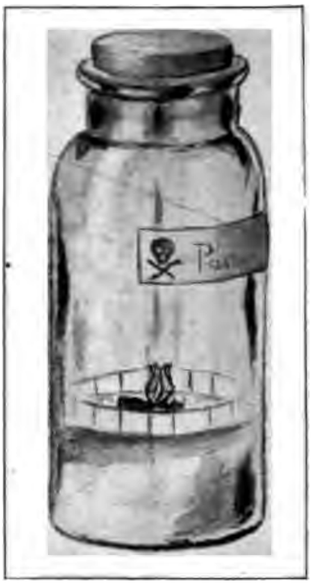

Fig. 3. Cyanide bottle.

Papering Specimens—When time and place do not suffice for the proper preparation of the butterflies, they may be placed in envelopes, until such a time as one is able to relax and properly mount them. The small dry envelopes are very good for this. The insect while in the net usually has its wings folded back. It may also be dropped into a triangular envelope made by folding a piece of paper as shown in Fig. 4, and a memorandum of the locality and date of capture is written on the envelope. They may then be packed in a shallow box, a cigar box being preferable.

When it is desired to pin and spread specimens that have been stored away they are relaxed. To do this take several large sheets of blotting paper, wet with water, place the papered butterflies on the sheets, then wet two more sheets and place over these. Do this as often as there are insects to be covered. Let them remain here two or three days, at the end of which time they can be spread as easily as when fresh. Care must be taken not to leave the specimens here too long lest they became mouldy.

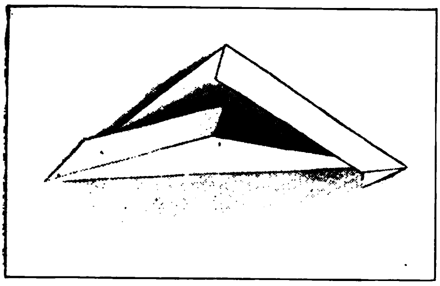

Fig. 4. Folded paper for insects.

In spreading insects, the insect should first of all be pinned, the pin being thrust perpendicularly through the thorax, leaving about one-fourth of the pin to view. It should then be placed upon the setting-board. Setting-boards are two pieces of board slanted toward the inside. Many collectors prefer straight boards, with a piece of cork beneath, and a groove on the upper surface of sufficient depth to accommodate the body of the insect and to permit the wings to be brought to a level of the upper surface of the board. When the insect has been pinned upon the board the next step is to set the wings in the position which they are to maintain when the specimen is thoroughly dry.

In bringing the wings into position, care should be taken to put the pin behind the strong nervure, on the costal margin of the wing; otherwise the wings are liable to be torn and disfigured. The rule is to draw the anterior wing forward in such a manner that the posterior margin of this wing is at right angle to the axis of the body, the axis being a line drawn through the head to the extremity of the abdomen. The hind wing should then be moved forward, its anterior margin lying under the posterior margin of the fore wing. When thus arranged slips of paper should be drawn over them and securely pinned to keep them in position, and the pins removed from the wings. Never pin through the wing. Next the antennae should be adjusted ,and placed parallel with the wings, and fine pins placed about them to hold them in position. Then if the body has a tendency to droop it should be raised by placing pins under it on either side. See Fig. 5.

When insects have been spread the board should be placed where they will be unmolested and free from dust. They should be left here for about a week, longer if the insect is very large, at the end of which time they may be taken off and put in the cabinet.

Labelling—Each specimen should have on the pin below the specimen a small label, giving the date of capture, if known, and the locality. Labels should be printed, or written in a fine hand, and preferably with India ink.

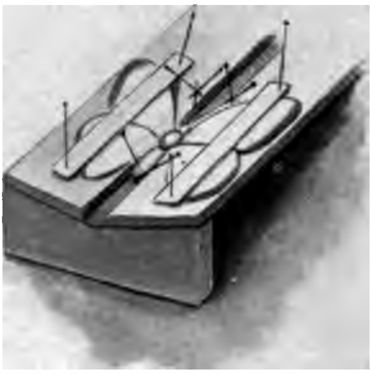

Fig. 5. Settling board, showing method of pinning and spreading insects for the collection.

Pins—The insect pins are made longer and thinner than ordinary pins.

Pins, pinning forceps, Fig. 6, printed labels, insect boxes and cabinets, sheet cork or peat, or other entomological suppiles may be had of dealers in this material. A jappanned steel pin is now on the market which is much superior to any pins heretofore made in that smaller pins may be used and still have greater stiffness and strength. For cabinets such pins are much more desirable, but at the same time are more expensive than ordinary pins.

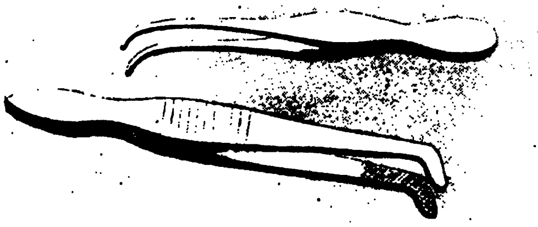

Fig. 6. Pinning forceps, for pressing pins into cork.

Venation of the Wings.

The thickened lines in the wings are termed the veins or nerves; and their arrangement is described as the venation or neuration of the wings. The thin spaces of the wings which are bounded by the veins are called cells. When a cell is not completely surrounded by veins it is said to be open.

The wings of different insects vary greatly in structure, but they are all more are less triangular in outline; they therefore have three margins; the costal margin or costa (a b); the outer margin b, c, and the inner margin c. a. The angle at the base of the costal margin and the outer margin is the apex of the wing; and the angle between the outer margin and the inner margin is the anal angle.

The principal veins of the wings are, beginning with the one lying on the costal margin, the costa, the subcosta, the radius, the media, the cubitus, and the anal veins. The radius media, and cubitus are usually branched and there may be several anal veins.

In some insects there are the premedia a vein lying between the media and radia; and a postmedia lying between the media and the cubitus.

I Costa
II Subcosta
III Radius
IV Premedia
V Media
VI Postmedia
VII Cubitus
VIII)
IX)
X) Anal
et al)

By referring to Figs. 7-12 these veins may easily be studied. As many of the generic distinctions are based on the venation it is essential that the student become thoroughly familiar with the locations and numbering of veins of wings.

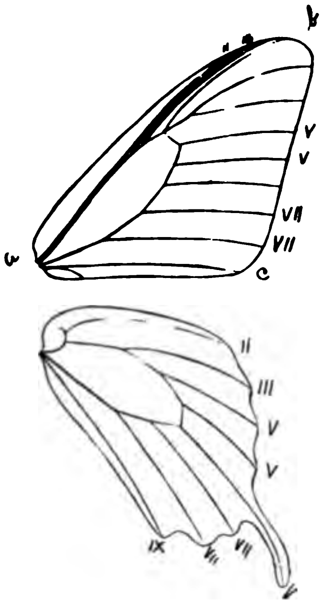

Fig. 7. Venation of wings, Papilionidae.

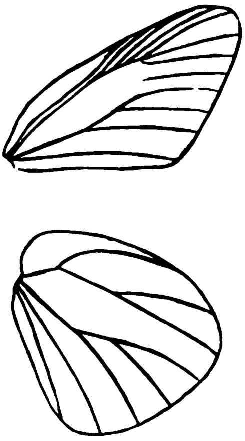

Fig. 8. Venation of wings, Hesperiina

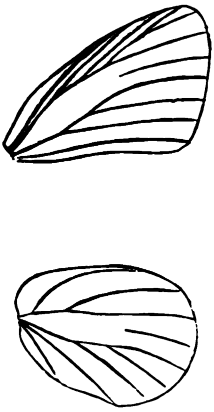

Fig. 9. Venation of wings, Lycaenidae.

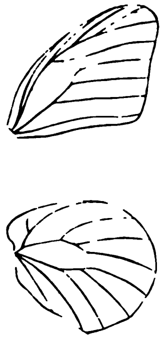

Fig. 10. Venation of wings, Pieridae.

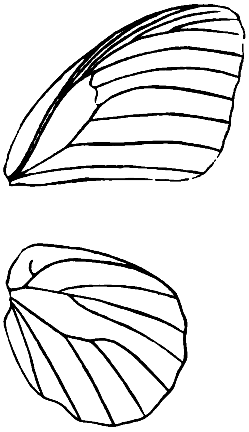

Fig. 11 Venation of wings, Nymphalidae, Argynnis leto.

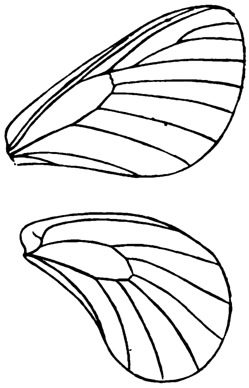

Fig. 12. Venation of Parnassius.

Key for Determation of Butterflies.

1. Antennae thread-like with a knob at the extremity.—2.
2. With the radius of the fore-wings five-branched, Fig. 8, and with all the branches arising from the discal cell; club of antennae usually terminated by a recurved hook. The Skippers. Hesperiina, page 142
3. With some of the branches of the radius of the fore-wwings coalesced beyond the apex of the discal cell, Fig. 7; club of antennae not terminated by a recurved hook. Butterflies. Papilionina, page13

SUPERFAMILY PAPILIONINA.

Key to Families.

1. Cubitus of the fore-wings apparently four-branched, Fig. 7. Papilionidae. P. 13
   Cubitus of the fore-wings apparently three-branched, Fig. 11.—2.
2. With six well developed legs, although in some species the fore legs of the male are a little shorter, and the tarsi of these lack one or both claws; radius of the fore wings, with rare exceptions, only three or four-branched. To determine the number of branches of radius, count the two cubital and the three medial branches first; the branches left between veins V and II belong to the radius.—3.
   With only four well developed legs, the fore legs being unused, much shorter than the others, and folded on the breast like a tippet (except in the female of Hypatus). Radius of fore wings five-branched, Fig. 11. Nymphalidae. P. 44
3. Vein V of the fore-wings arising at or near the apex of the discal cell, Fig. 9, except in **Feniseca tarquinius,** in which the wings are dark brown, with a large fulvous spot on each. Lycaenidae. P. 124
   The first branch of media of the fore wings united with the last branch of the radius for a considerable distance beyond the apex of the discal cell. Fig. 10. Ground color of the wings white, yellow or orange. Pieridae. P. 26

FAMILY PAPILONIDAE.

Key to the Subfamilies.

Hind wings with a tail like prolongation; ground color of wings black; radius of fore wings five-branched; the base of vein VIII of fore wings preserved as a spur like branch of vein VII, Fig. 7. Papilioninae. P. 19

Hind wings without tail like prolongation; ground color of wings white; radius of fore wings four-branched; vein VIII of fore wings wanting, Fig. 12. Parnassiinae. P. 13

SUB-FAMILY PARNASSIINAE.

The Parnassiinae differ from the Papilioninae in lacking the tail-like prolongation of the hind wings and in that the ground color of the wings is white, but resemble them in possessing similar scent organs in the larval state. They are found only on high mountains or far north.

Key to Genera.

Medium size, diaphanous wings, white or yellow in color, marked with black spots and round pink or yellow spots margined with black. Parnassius.

Genus PARNASSIUS, Latrielle.

Butterfly—Medium size, with diaphanous wings, generally white or yellow in color marked with black spots, and round pink or yellow spots. The head is relatively small, thickly clothed with hairs. The antennae are short and straight. The wings have a rounded apex. The upper radial is lacking.

Early Stages—The egg is turban-shaped. The caterpillars have very small heads. They are flattened and dark brown or black in color with light spots.

Key to Species.

Males with very light wings, black reduced to a row of marginal and sub-marginal lunules, the latter often lacking. Females with the whole upper surface of primarus smoky black. Antennae with black and white rings, black knobs. smintheus.

Males with darker wings, a sub-marginal row of white lunules. Females much like males ,but darker. Antennae black . clodius

THE PARNASSIUS BUTTERFLY.

Parnassius Smintheus, Dbl. and Hew., var Hermodour. Fig. 13, Male; Fig. 14, Female.

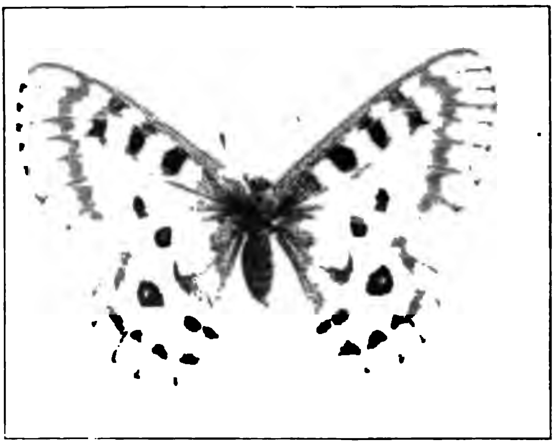

Fig. 13, **Parnassius smintheus, var. hermodour, male.**

Butterfly—This beautiful insect is subject to great variations. The expanse of the wings of the female is 2.25-3.00 in., male 2.00-2.50 in. The white ground is marked with smoky black to a greater or less extent. On the wings are yellow or pink spots, varying in size, margined ck. There is a marked difference between the females and males, ɜr being much whiter with the smoky black confined to the outer ɔf the wings and the inner edge of the hind wings. There is a ɪr in the middle of the discal cell of fore wings, another at the ıd of the cell, beyond which is a more or less prominent bar with ɔut red spots (one or two). The female is much darker, with the pper surface of the primaries usually smoky-black hue, slightly rent, the usual bands being lost in the ground color of the wing. or pink spots much larger than in the male.

variety **hermodour** is much blacker than **smintheus**. Both are ı the state. Comparison of specimens from Montana with those ke's Peak show the latter to be much smaller, and lighter. As

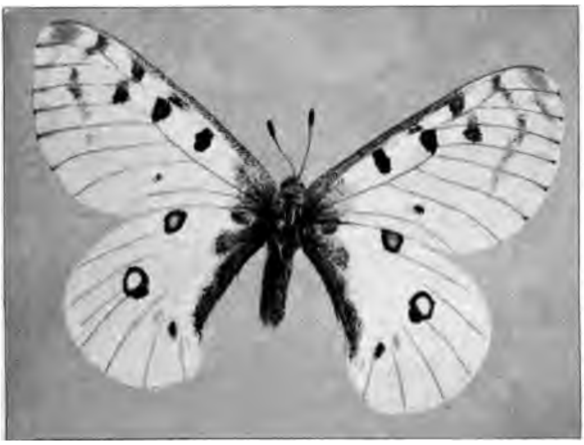

Fig. 14, **Parnassius smintheus**, var. **hermodour**, female.

e's Peak specimens are from altitude 12,000 feet and Montana ns from 3,000 to 7,000 this is to be expected.

se butterflies are truly Alpine, and fly for but a short season of r. The lowest altitude at which they have been taken is about et near the Biological Station at Flathead lake. At Missoula e rare, and have not been taken below 5,000 feet, and then in umbers. They fly lazily but easily. Owing to the fact that they ally taken at high altitudes their capture results in much fatigue. ıey sail gracefully over a cliff when the pursuer is all but ready weep of the net. In the same locality high eleavtion seems to n smaller and blacker specimens, low elevation in larger and ɔnes.

tribution—The University collection contains specimnes from a, Tobacco Root Mountains, Mission Mountains, New Chicago, ı Lake, Geyser Basin, Flathead Lake, the Swan Range and the l Park. It is found at higher elevations throughout the state, from Colorado to California, Montana to New Mexico. Its north-it is unknown. According to Edwards it has been taken as far as Loggan, Alberta. Coubeaux has collected it at Sheep Creek near Big Sandy. He says it is not common in the Highwood and Little Belt Mountains, and that it seems to be absent from the Bear Paw Mountains.

Food—The caterpillar feeds on Sedum and Saxifraga. The butterfly is common in the mountains about Helena (Brandegee). Cooley has collected it at Bozeman.

THE CLODIUS BUTTERFLY.

Parnassius clodius Menetries, Fig. 15.

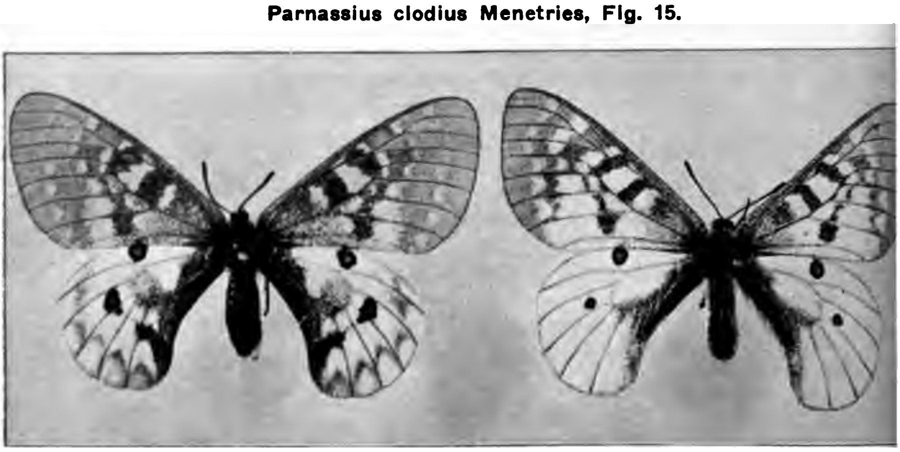

Fig. 15, **Parnassius clodius.**

Prof. R. A. Cooley, of the College of Agriculture and Mechanic Arts at Bozeman, has sent us two specimens, male and female, of this species, taken in Gallatin county, where he reports them rather abundant. The pink and yellow spots are lacking on the primaries in both sexes.

The male has more smoky brown on the outer edge and base of primaries, with more translucent outer margin. The differences are more clearly shown by comparison of Figs. 13 to 15.

Distribution—**Clodius** is found upon the mountains of California. It is reported from the state by Prof. Cooley as stated. Carrington and Logan collected it on the expedition in 1871.

Food—The capterpillar feeds on Sedum and Saxifraga.

Collecting Butterflies at High Altitudes.

My first high altitude collecting was at 11,500 feet at Seven Lakes, Pike's Peak. It was in August, 1892. Ice formed at night, and all insect life was quiet. During the warm days butterflies were abundant. For the first time I saw Parnassius in all its splendor. But to capture it was difficult. Not being accustomed to the high altitude I was unable to make vigorous effort, and after a short chase would drop to the ground gasping for breath. Our camp was in the valley on the bank of one of the "Seven Lakes," in the home of **Parnassius smintheus.** They were out by the thousands. A few miles from camp, toward the main summit, an irrigation or water ditch had the surface of the water covered as far as we could see in either direction with dead or struggling larvae of **smintheus.**

Above timber line and up to the line of perpetual snow there is in summer a profuse growth of Alpine flowers. One who has not seen high altitude vegetation cannot comprehend the beauty, splendor, and profusion of high altitude or alpine flowers. They are a sight never to be forgotten. Above timber line there is in summer a profuse growth. On sheltered or sunny slopes there is a varied vegetation, the flowers making a beautiful sight. One of these visions is the most gorgeous I have ever seen or ever hope to see.

I was caught in a shower of rain, hail, sleet, and snow, and had hastened to a large rock. By clinging with both hands and feet I was somewhat protected. After an hour the storm passed, and the sun came out bright and warm. Sunshine always brings out insects, if they are about. The storm left a deposit of snow an inch or two in depth over the surface of the mountain for miles around. Above the snow, showing their varied colors, were thousands of flowers of different tints, from the genera **Actinella, Allium, Mertensia, Silene, Castilleia, Polygonum, Geum, Sedum,** and **Potentilla.** Hovering over these flowers were hundreds of butterflies, displaying their gorgeous colors. It was a rare sight, and a rare combination of snow, alpine flowers and alpine butterflies. The insects were **Parnassius smintheus, Colias ochraeus, Colias meadii, Argynnis eurynome, Phyciodes nycteis, Argynnis helena,** and **Lycaena rustica.**

Such a blending and contrast of colors is rarely seen, and forgetting everything I stood for a long time drinking it in. This view is indelibly stamped on my memory. It cannot be forgotten. Soon the mournful squeak of the pika on the rocks nearby called my attention, as it was the pika I was after. In a short time the snow had disappeared, and the six mile walk to camp was cheerfully made.

It has not been my good fortune to climb high mountains. I have done no collecting above 14,000 feet. Among the Rockies of Montana my work has been at altitudes below 10,000 feet. My next attempt at collecting at altitudes higher than common was in the National Park, at an altitude of 8,500 feet. Again I saw **Parnassius smintheus,** that gorgeous insect of the alpine realm. I gave chase, and after landing the prize in the net sank to the ground exhausted and gasping for breath. In the Mission Mountains of Montana I have had many a happy day among the peaks at 9,500 feet and lower. This short range has some of the most beautiful mountain scenery in the world. Many of the insects taken are recorded in this work. I have collected in the Swan range, and in the main range of the Rockies, at altitudes up to 10,000 feet. In northern Montana timber line is 9,500 feet. In Colorado it is about 11,500 or 12,000 feet. These two elevations in the different localities will probably have about the same flora and fauna, or at least similar conditions. Never have I found insects so abundant as at Seven Lakes on Pike's Peak, and rarely are they abundant. Quite frequently but a single specimen is captured, often but a few. For several years we have annually made the ascent of MacDougal Peak in the Swan Range, whose elevation is approximately 7,600 feet. On these occasions I stay behind to see that all are going down safely. I always loiter on the summit or along the long ridge, collecting a few **Lycaenas, Argynnids, Pierids,** or **Phyciodes.**

If the butterfly students of Montana will seek healthful exercise, magnificent view of snow-clad mountain summits and peaceful wooded valleys, with a catch of few but rare and very choice insects, let them ascend some high peak in July or August, seek a sunny slope of open woods and abundant vegetation, and pitch their tents for a week. It will add years to the latter end of life. M. J. E.

View of MacDougal Peak, Swan Range, Montana, in August, showing ypical country for Alpine collecting. The summit is about 7,700 feet. round the top on sunny days one may always catch an abundance of nsects. Photo by *M. J. E.*

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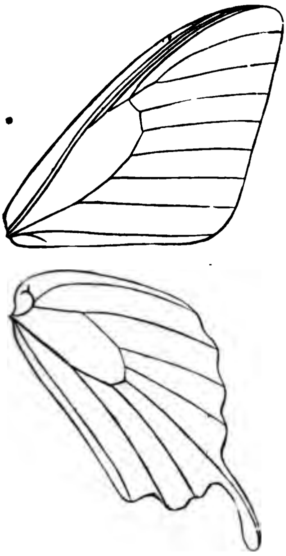


Fig. 16. Venation of Papilio.

SUB-FAMILY PAPILIONINAE.

Large species, hind wings tailed. Ground color of the wings black, usually marked with yellow, and often with metallic blue or green, or yellow marked with black. Papilio.

Genus PAPILIO, Linnaeus.

Butterfly—There is great diversity of form in the wings of this genus. They are large butterflies, often known as swallow tails. The wings are ample; the fore wings triangular; the hind wings concave next to the body, and usually provided with a tail-like appendage before the anal angle; outer margin dentate. See Fig. 16.

Early Stages—The eggs are somewhat globular, flattened at the base, and smooth. The caterpillars are cylindrical, fleshy, thicker in the anterior portion of the body.

There are about twenty-seven species of this genus found within the limits of boreal America.

KEY TO SPECIES OF PAPILIO.

1. Ground color yellow, with black bands. 2.
Ground color black, with whitish yellow or white bands. 3.
2. One tail, rutulus.
Two tails, daunus.
3. One tail; base of fore wings black; an orange lunule with black ocelli on hind winks, 4.
One tail; but little black at base of fore wing, whiter, eurymedon.
One tail; base of fore and hind wings broadly black. nitra.
4. Sides of thorax yellow, brucei.
Sides of thorax black, zolicaon.
5. Row of marginal spots on under side of fore wings blending rutulus
Row of marginal spots on under side of fore wings separate turnus

THE DAUNUS BUTTERFLY OR SWALLOWTAIL.

Papilio daunus. Boisduval. Fig. 17.

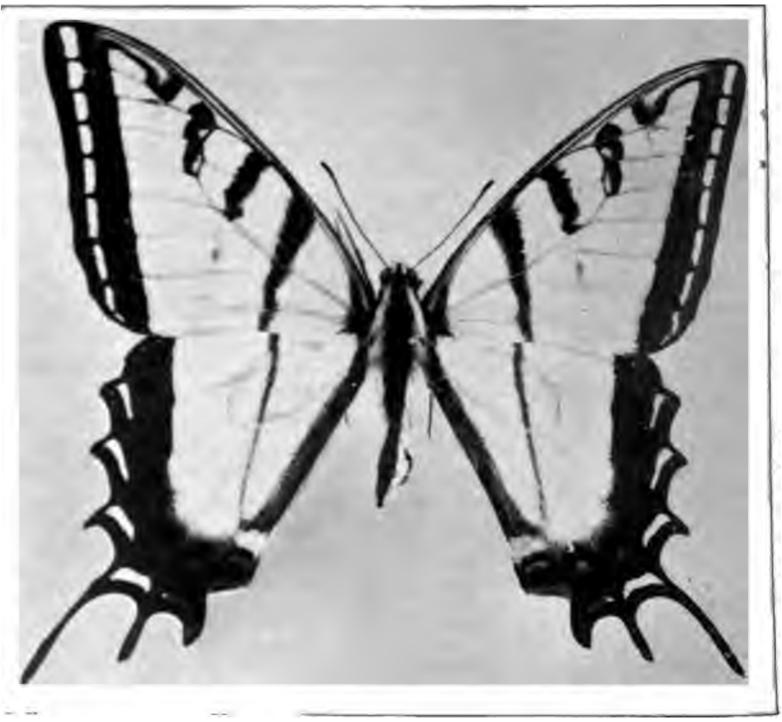


Fig. 17, **Papilio daunus.**

Butterfly—Expanse 4.00-5.25 inches. Upper surface of wings clear yellow, costa and outer border of fore wings and posterior border of hind wings black. The black along the costa is suffused with yellow, eight spots in the fore and four lunules in the hind wings. The lunule on the hind wings is orange color. There are four black bands on the fore wings. The first is continued two-thirds across the hind wings and is about one-fourth the distance from the base to the outer margin. The second extends from the costa to a little beyond the median vein; the third extends from the costa across the discal cell; the fourth from the costal to the fifth sub-costal venule. The black terminal border of the hind wings contains blue clouds. It has two tails which are black, edged on the inside with yellow. The under side is similar to the upper. The body is black with yellow stripes on each side.

It is the largest of our butterflies, very conspicuous when on the wing, and eagerly sought by the young entomologist. It is apparently absent from the treeless eastern end of the state.

Food—The early stages have not been thoroughly studied, but it is allied to the other members of the family. The caterpillar feeds on a great variety of plants.

Distribution—It is found among the eastern valleys of the Rocky Mountains and descends into Mexico. In Arizona it is quite common. In Montana it is on the wing by the last of April. It is very similar to the **turnus** of the eastern and middle states, but is larger, and with two tails to the wings. It is rather common in the western end of the state, but nowhere abundant. Wiley does not report it from the eastern end, except to refer a specimen on the wing to either daunus or rutulus. Brandegee has taken it at Helena.

THE TURNUS SWALLOW-TAIL.

Papilio turnus, Linnaeus.

Butterfly—Expanse of male, 3.00 to 4.00 inches, 75 to 100 mm.; female, 3.50 to 5.00 inches, 87 to 125 mm. This species very closely resembles **rutulus**, or, rather, **rutulus** very closely resembles **turnus**. It may be distinguished by the fact that the marginal spots on the under side of the fore wings are separate, while in **rutulus** they join together. The species is dimorphic in the female sex in the southern portion of the territory it occupies. At first the black form was regarded as a distinct species, but it is now known that the black and yellow females are of the same species. By experiments it is shown that eggs from yellow females produce black females, and conversely eggs from black females produce yellow females. The dark or black female does not occur in Canada or in the country northward and westward. Holland has obtained specimens of a small dwarfed yellow form near Sitka.

Early Stages—The egg is green or bluish green, with occasionally some reddish spots. The caterpillar feeds on the wild cherry and other plants.

Distribution—It abounds in the wooded regions in the eastern United States, often in great numbers, extending from New England to the Gulf of Mexico. Westward it is found to the Rocky Mountains, extending northward to Alaska. In the state it has been taken by Carrington and Logan in 1871, locality not given.

Several specimens of **turnus** are among Wiley's specimens in his Miles City collection.

THE RUTULUS BUTTERFLY.

Papilio rutulus, Boisduval, Fig. 18.

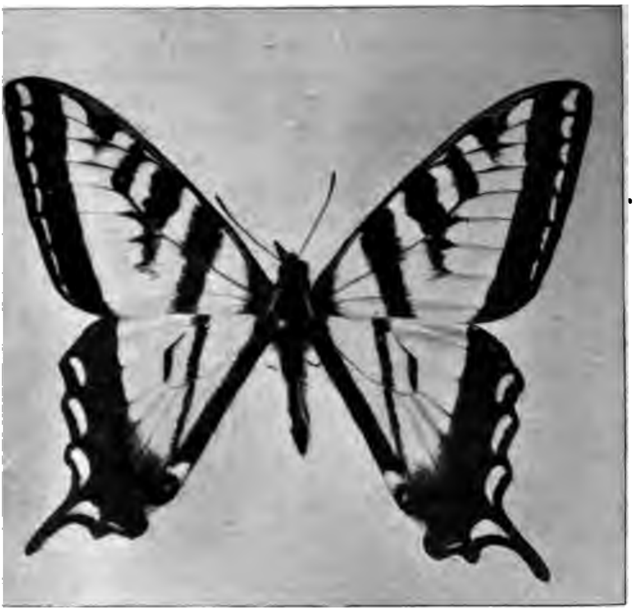


Fig. 18. **Papilio rutulus.**

Butterfly—It resembles **P. daunus** in color and markings, but the black bands are broader and it has not the two decided tails. The marginal spots on the under side of the fore wings run together, forming a continuous band. Expanse, male, 3.50-4.00 inches; female, 3.75-4.25 inches, 94 to 106 mm.

This species also closely resembles **P. turnus**, and displaces **turnus** on the Pacific Coast. It is not uncommon. At Missoula it flies as early as May 10. At Swan lake it is abundant in June. It is found as high as 6,100 feet at Missoula.

Food—It feeds on alder and willow, which are very abundant along all Mountain streams.

Distribution—It is a Pacific species. Found throughout the western part of the state. Not reported at Miles City, except as mentioned under **daunus.** Brandegee reports it from Helena. It is fairly common at Bozeman, according to Cooley.

THE EURYMEDON BUTTERFLY.

Papilio eurymedon, Boisduval, Fig. 19.

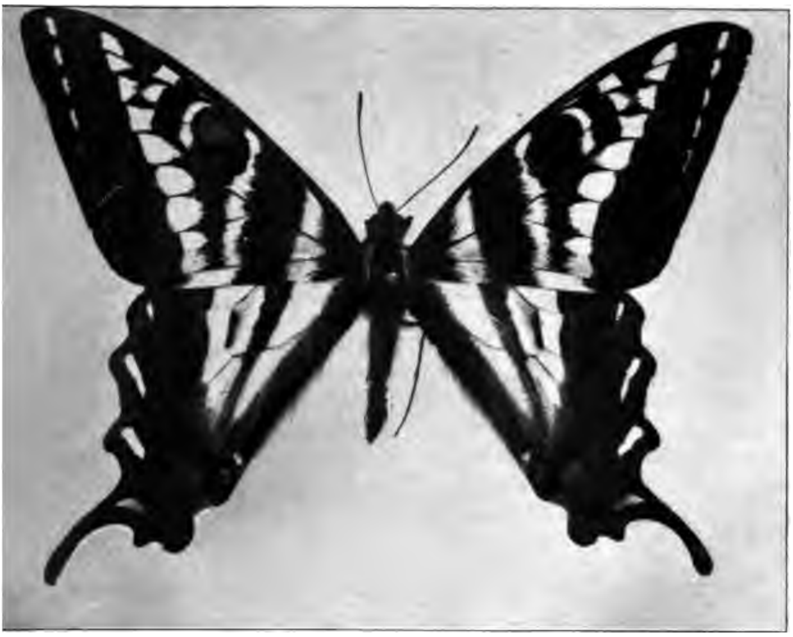


Fig 19, **Papilio eurymedon.**

Butterfly—In the style of its marking it resembles **P. daunus,** but e ground color is always pale whitish yellow or white, and the white arginal spots on the under side of the fore wings continuous as in **. rutulus.** Expanse 3.50—4.00, 87—100 mm.

In the western part of the state it is the most abundant species, ying as early as April 30, and taken through May, June and July.

Food—The caterpillar resembles **P .turnus,** but may be distinguished y its paler color and the much smaller spots composing the longitudinal eries on the back and sides, and by the different color of the head. It eeds upon a variety of plants, and is especially partial to **Rhamnus alifornicus.**

Distribution—The species ranges from Mexico to Alaska, eastward to olorado. It is abundant in the valleys of the Coast ranges, and is very ommon in the canyon of the Frazer river, British Columbia, in June. ommon, though not abundant, around Missoula, and taken in the Mission mountains and at Swan lake. It has been taken at 6,000 feet at Ielena by Brandegee. At Bozeman it is not very abundant (Cooley). Viley has one specimen from Miles City.

BRUCE'S SWALLOWTAIL.

Papilio brucei, Edwards, Fig. 20.

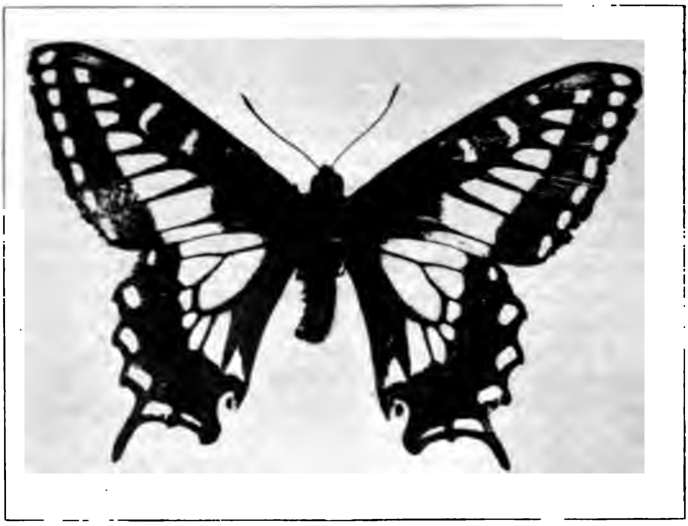


Fig. 20, **Papilio brucei.**

Butterfly—Expanse 3.25-3.60 inches. Under surface yellow, with black borders ,the same as in **P. daunus.** The base of the wings is black and it extends in such a way as to make the discal cell appear black with three yellow bars. It has the yellow spots in the black along the costa. It has one tail, and black marking on the veins. The last lunule in the hind wing is orange with a black ocellus. The hind wings have the blue clouds. The body is black. It is thought to be the result of a union between **P. oregonia** and **P. bairdi.**

Food—The caterpillar feeds on Umbelliferae, and is common on parsley and parsnips in gardens.

Distribution—In Colorado and adjacent regions **P. oregonia** meets with the form **bairdi** which ranges northward from Arizona. Hybridization is thought to have occurred, resulting in the fixed form **brucei,** breeding either toward **bairdi** or **oregonia. Oregonia** is found in Oregon and Washington, where **bairdi** is absent. We formerly captured a specimen identified by Edwards as **oregonia** and another as **bairdi** near Idaho Falls, which lends support to the hybridization idea. We have sought for **oregonia** in Western Montana, but have found none which could be so called. Most of our specimens have been taken from Missoula. One was taken in the Mission mountains. Cooley has specimens from Bozeman, thought to be **zolicaon.** Possibly Wiley's **zolicaon** may be **brucei.**

THE ZOLICAON BUTTERFLY.

Papilio Zolicaon, Boisduval, Fig. 21.

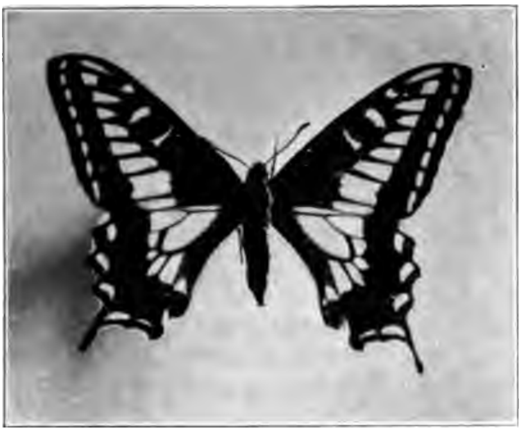


Fig. 21, **Papilio zolicaon.**

Butterfly—Expanse 3.25-3.75 inches. Upper side of primaries black, marked and spotted with deep yellow; of secondaries yellow from base nearly two-thirds the distance to margin, beyond black; primaries have a sub-marginal row of eight spots, and a discal series of eight forming a band across the entire wing; the first discal spot excavated on the upper side, sometimes divided into two. Secondaries with a broad black border which incloses a sub-marginal series of six yellow spots, the first often wanting; an orange or deep fulvous spot, inclosing a round or oval or black spot, and edged on the upper side by a blue crescent, the ring occasionally wanting; the rest of the wing yellow, divided into eight spots, the cell being one, by the black nervures. Under side nearly as above, the colors paler.

Food—The caterpillar feeds on the Umbelliferae, fennel, carrot and celery.

Distribution—Southward from Vancouver's Island to Arizona, eastward to Colorado. Reported by Wiley to be rare at Miles City. Collected by Dr. Hayden in Montana in 1871.

THE NITRA SWALLOWTAIL.

Papilio nitra, Edwards.

Butterfly—This butterfly is very nearly related to **zolicaon**, but the black is widely spread over the base of the wings so as to make the yellow appear like a broad band, and the two yellow bars in the fore wings are very indistinct.

Holland reports this insect rare in collections, and says it has sprung from the same original stock as **zolicaon** and **aliaska**, the latter being an offshoot from the Asiatic butterfly. We have not seen the species.

Food—Early stages and food unknown.

Distribution—It occurs in Montana and the portions of British America adjacent on the north.

FAMILY PIERIDAE.

Small or medium sized; hind wings not tailed; white or yellow in color; with dark marginal markings. Pierinae.

SUB-FAMILY PIERINAE (The Sulphurs and Whites.)

Medium sized or small butterfly, white or yellow in color, with dark marginal markings. In many genera the sub-costal vein of the fore wing has five, or even six nervules, and the upper radial is lacking in this wing. The eggs are spindle shaped, marked with vertical ridges and cross lines. The caterpillars are cylindrical, generally green in color. The chrysalids are generally more or less jointed at the head.

Key to Genera.

1. Antennae abruptly terminating in an ovoid club. 2.
   Abtennae terminating in an obconic club. 4.
2. Abdomen shorter than the hind wings; color white or very pale yellow. 3.
3. Underside of hind wings without marks, or marked along the veins; size, medium. Pontia, P. 27
   Underside of hind wings marked with a greenish net-work; small size. Synchloe, P. 32
4. Hind wings with an orange discal spot, both wings with black border Eurymus, P. 37
   Medium sized; costa black as far as the end of the cell; transparent white wings; apex black with white spots. Neophasia, P. 26

Genus NEOPHASIA Behr.

Butterfly—Medium size, white in color. The upper radial is lacking, and the sub-costal is provided with five branches, the first emitted well before the end of the cell.

Early Stages—The egg is flask shaped. The caterpillar in its mature form is about an inch long. The body is cylindrical, terminating in two short anal tails. The color is dark green, with a broad white band on each side. But one species is known.

Key to Species.

Almost a transparent white, a black border to fore wings, and a black bar across the discal cell, meeting the border, menapia.

THE PINE WHITE.

Neophasia menapia Felder. Figs. 22, 23.

Butterfly—Medium sized; hind wings white with dark veins on the under side; black and white apex.

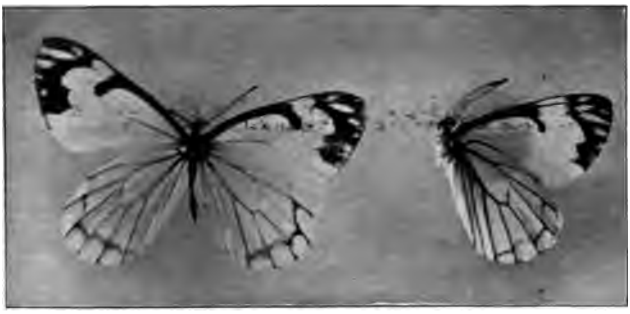


Fig. 23. **Neophasia menapia.**

Early Stages—Described by Edwards. "The caterpillar infests the pine trees and firs of the northern Pacific States. The larva lets itself down by a silken thread, often a hundred feet in length, and pupates on the ferns and shrubbery at the foot of the trees. It sometimes works great damage to the pine woods."

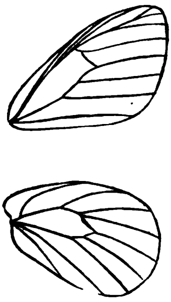


Fig. 22. Venation of **Neophasia menapia**

Distribution—It does not seem abundant in the west end, but has often been seen in the Mission mountains and about the laboratory at Big Fork high up in the coniferous trees out of reach of the collector. At Swan lake it was found rather abundant late in August, 1903. In Auguist, 1904, about 40 were taken in a half hour, about half way up the lake. The collecting region at Swan lake for this species is along the lower half of the lake shore. Very few have been seen around the upper end.

Genus PONTIA FABRICIUS.

(The Whites). Fig. 23.

Butterfly—White, more or less marked with black, occasionally the white is tinged with yellow. The outer margin of the primaries is straight, the outer margin of the secondaries is more or less evenly rounded. The egg is spindle shaped. The caterpillar is elongate, the head hemispherical. The chrysalis is attached by the anal extremity, and held in place by a silk girdle.

Key to Species.

1. Fore wings with a black bar at the end of the cell, and more or less of a black border, 2.
Fore wings with no black bar at the end of the cell. 3.
2. Markings on under side concentrated in brownish blotches, protodice.
Markings on under side of hind wings green blotches on the disk, beckeri.
Markings on under side as rays on either side of the veins, occidentalis.
Veins of fore wings black, spots smaller. sisymbri.

3. Under side of hind wings plain yellow. No marks along the veins, rapae.
Under side of hind wings marked along the veins, 4.
4. Black border to both wings, monuste.
No black border to wings, 5.
5. Under side of hind wings pale yellow, with brownish along the veins, napi.

THE PROTODICE BUTTERFLY, OR SOUTHERN WHITE.

Pontia protodice Bois. and LeConte. Fig. 24.

Summer form, **protodice**, Bd. and Lec. Expanse of wings from 1.6 to 1.8 inches, 40 to 45 mm.

Male. Upper surface white, fore wings with a broad black dash or bar across the end of the discal cell, and a sub-marginal row of three more or less distinct spots, the last almost or quite touching the hind margin. Traces of rays run from this row to the outer edge. Hind wings without spots. Bars and spots are repeated on the under side. Veins of hind wings are broadly marked with greenish yellow sprinkled with brown seals, and the tips of the fore wings tinged with greenish yellow.

Female. Color and spots as in male, but the spots have a tendency to blend, and the outer margin supports a border of triangles connecting with the subterminal row of rays. Hind wings with subterminal zigzag blackish line, outer portions sending rays to the margin, where they are somewhat expanded. The base of both wings are more sprinkled with dark scales than in the males. Under side similar to that of the male.

Winter form, **vernalis**, Edw. Smaller than summer form, the dark colors more prominent. Spots of subterminal row of fore wings more inclined to be connected. Expanse scarecely 1.6 inches. Body black, with some white hairs and scales.

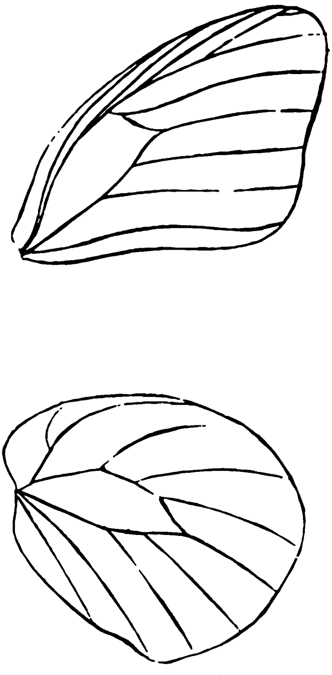


Fig. 24. Venation of Pontia. (P. protodice)

Distribution—This insect is usually known as the Southern Cabbage butterfly, though it is to be found everywhere east of the Rocky mountains. It is injurious in the larval state in the southern states. In the northern states **P. rapae** is more common, in many places driving out **protodice**. There are several broods during a season.

Wiley has taken it at Miles City; Brandegee has collected it at Helena; Cooley has it from Bozeman; Douglass collected it in the Ruby Mountains and Madison Valley; Elrod has taken it at Missoula, Flathead Lake, and in the Mission Mountains, Coubeaux has it from Big Sandy. Collected by Coues along the 49th parallel in 1874.

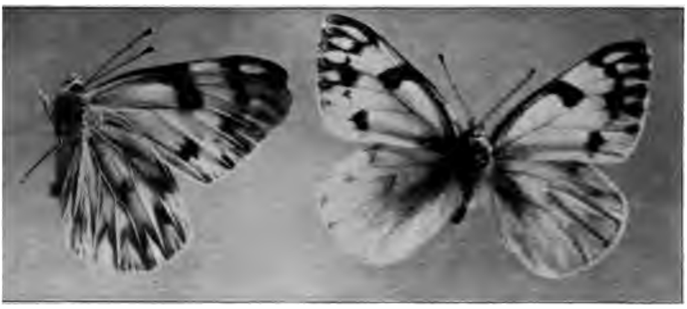


Fig. 25, **Pontia protodice.**

s food consists of cruciferous plants. It is destructive to cabbage.

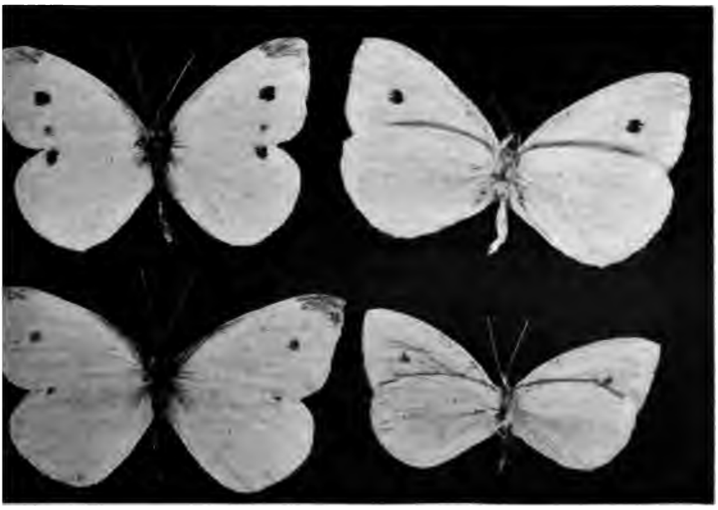
THE WESTERN WHITE, Pontia occidentalis Reakirt.

utterfly—Size about 1.75 inches, distinguished from **P. protodice** by ıaller size and different markings. On the under side of the wings ark markings are not concentrated in blotches, but are in broad udinal rays on either side of the veins from the base to the outer n. Spots on the upper side much smaller than in **protodice,** and . The females are sometimes lemon yellow above.

arly Stages—Similar to those of **protodice.**

istribution—It is found from the Rocky Mountains to the Pacific. has it in his collection from Miles City; Cooley has taken it at ıan; Brandegee at Helena; Douglass at Madison Lakes; Elrod at ula, and on MacDougal Peak. It is likely to be found any place in ate. Allen has taken it at Dillon. Coues collected it in 1874 along)th parallel.

E CABBAGE BUTTERFLY. Pontia rapae, Linnaeus. Fig. 26.



ig. 26. Pontia rapae; upper figures show both surfaces of female, figures *same for male.*

Butterfly—Known as cabbage butterfly; yellowish white, with apex of fore wings black. Two black spots on fore wings and one on the hind wings. Underneath, the apex of the fore wings and the entire surface of the hind wings are pale lemon yellow. In the female two spots on outer part of fore wings, in male only one.

The larva feeds principally on cabbage. Its color is green like the cabbage leaf, with a narrow greenish lemon yellow dorsal band. The body is clothed with very fine short hairs.

Distribution—This common species is an importation from Europe. It reached Quebec in 1860; how, no one knows, perhaps in cabbage. By 1881 it had spread over the eastern half of the continent, from Hudson Bay to Southern Texas. In 1886 it had reached Denver, and in 1884 had reached the head waters of the Missouri. It now possesses the cabbage fields from the Atlantic to the Pacific, "to the incalculable damage of all who provide the raw material for sauerkraut." The injury done by the caterpillar is estimated to amount to hundreds of thousands of dollars.

It is probably to be found all over the state, and has been taken at almost every place where collections have been made, at Missoula, Miles City, Bozeman, Helena, University of Montana Biological Station at Flathead Lake, Mission Mountains. It does not seem as common as **P. protodice.** Allen collected it at Dillon.

THE MUSTARD WHITE.

Pontia napi Linnnaeus. Fig. 27.

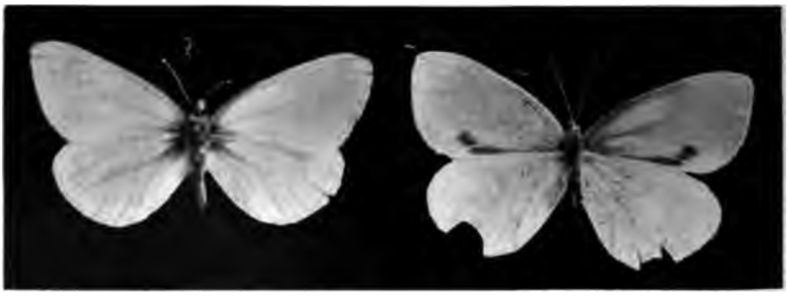


Fig. 27. **Pontia napi, No. 1, var.pallida No. 2, var. acadica.**

Butterfly—Expanse of wings, about 1.75 inches. In general shape and appearance it resembles **protodice** or **rapae.** General color while, with grayish vein markings, some with a dusky spot on the wings, or dusky at the base of the wings. A Protean, cosmopolitan species, existing in many forms, the result of climatic and local influences, which has a very wide distribution. The different forms are to be found from Arctic America as far south as California on the west, and Michigan and New England on the east. It is mostly represented in the regions farther to the north. The typical form is found in Europe, rarely in North America, although Holland has specimens from the Pacific Coast region which he says are absolutely indistinguishable from European specimens in color and markings.

Var. **pallida,** Scudder. The wings are white above and below, with small black spot on the fore wing of the female above, and hardly any trace of dark shading along the veins on the under side; a trace of dark on the hinder edge and base of fore wings. One specimen taken at Flathead Lake, August, 1903. One taken in the big meadows at the upper end of Swan Lake, August 8, 1904.

Var. **acadica,** Edwards. The veins of the wings have narrow border above and below of blackish, more pronounced in the female, base of wings and sometimes the tips dusky. The under side in both sexes and the upper side in the female are distinctly yellowish. Specimens from Montana have been examined as follows: One from Helena (Brandegee) June 26, 1902; four from Missoula, one April 28, 1900, one June 1, 1900, one June 12 1899 one October 1897; one from Bozeman (Cooley); three from Miles City (Wiley).

THE CALIFORNIA WHITE.

Pontia sisymbri, Boiduval Fig. 28.

Butterfly—Expanse of male, 1.2 to 1.6 inches, 33 to 40 mm.; female, 1.6 to 2.00, 40 to 50 mm. Upper side of male white with a faint yellow tint; bases of wings dusted with black; primaries have the costal margin gray for three-fifths the length from base; the ends of the nervules from apex to second branch of median covered by black bars, which diminish gradually in length down the margin; midway between margin and cell is a transverse black band, interrupted opposite cell, and running from costa to upper median interspace; in the arc a black bar, indented on outer side; secondaries immaculate; fringes of both wings white; black at the ends of the veins.

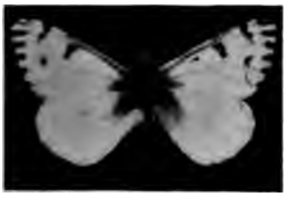


Fig 28. Pontia Sisymbri.

Under side same color; the markings repeated, but paler or gray, the bars along margin of primaries greenish-gray.

Body gray above, thorax white below, abdomen yellowish; legs white, palpi white with black hairs in front; antennae black above, whitish beneath; club black, the tip orange,

Female similar to male.

Early Stages—The eggs are long, narrow, conical, the base and top flattened, depressed; ribbed longitudinally, and crossed by numerous striae; color when first laid yellow, shortly before the end of the stage red. Mature larva about .9 inch, 25 mm., color light yellow crossed with stripes of black. The caterpillar feeds upon the cruciferae.

Distribution—Found in Colorado and the Pacific states. Collected by Elrod at Missoula.

BECKER'S WHITE.

Pontia beckeri, Edwards.

Butterfly—Expanse, 2 to 2.2 inches, 51 tc 56 mm. Easily discriminated from all other allied species by the green markings on the under side of the hind wings, concentrated in broad blotches on the disk; by these markings the species recalls the species of the genus euchole.

Male. Upper side pure white; base of wings not powdered with black, as in allied species; at the outer edge of the cell a dense black subrectangular spot (not reaching the costa), with a central white streak. Secondaries immaculate.

Under side white; the veins at apex and on upper hind margin bordered by black scales and suffused with greenish yellow; cellular spot enlarged, its base broadened and posterior edge excavated.

Secondaries have all the veins and branches yellow; those terminating on hind marg.n edged by broad bands of yellow green reaching to middle of disk and connected anteriorly; three large spots of same color about the cell; another large triangular subapiçal spot on costa; the veins at base banded with green; all these bands and spots slightly sprinkled with black scales.

Body above gray, yellowish beneath abdomen, white beneath thorax; legs white; palpi white, grey on upper side and at tip. Antennae white above and at base below, beyond brown; club black, tip pale fulvous.

Female. Similar to male, but with larger and more numerous spots; secondaries with black spots and dark streaks along the veins; under side with a round black spot in submedian inter-space on primaries, in addition to discal black spot.

Early Stages—The mature larva is 1.25 inches, 32 mm. long, greenish white, thickly marbled or sprinkled with gray, and with a very distinct orange belt between the segments; each segment also has 16 or 18 jet black tubercles which taper into black bristles; the head is tinged with yellow. It feeds on cruciferous plants.

Distribution—From Washington to Central California, east to Colorado. Taken in the state by Cooley at Bozeman, and by Allen at Dillon.

Genus SYNCHLOE, Huber.

(Euchloe-Anthocharis.) Fig. 29.

Butterfly—Small butterflies, white in color, with the apical region of the primaries dark-brown, marked with spots and bands of yellowish orange or crimson. On the underside the wings are generally more or less profusely mottled with green spots and striae.

Egg—Spindle shaped, laterally marked with raised vertical ridges, between which are fine cross lines.

Caterpillar—In its mature stage, it is relatively long, with the head small.

Chrysalis—With the head relatively projecting; wing cases compressed.

Key to Species.

1. Orange apex, surrounded by black; lower surface of hind wings complete green network, **sara.**
   No orange at apex of fore wings, **2.**

2. Having the tips of wings marked with gray; a conspicuous bar at the end of the cell, 3.
3. Under side; apex of fore wings with many green scales; hind wings with a network of greenish yellow scales. creusa.

   Under side; apex of fore wings with a few green scales; hind wings crossed with several green bands, outer one trifid, olympia.

   Under side; hind wing with three irregular bands, outer one much forked, ausonides.

THE AUSONIDES ORANGE-TIP.

Synchole ausonides Boisduval. Fig. 30.

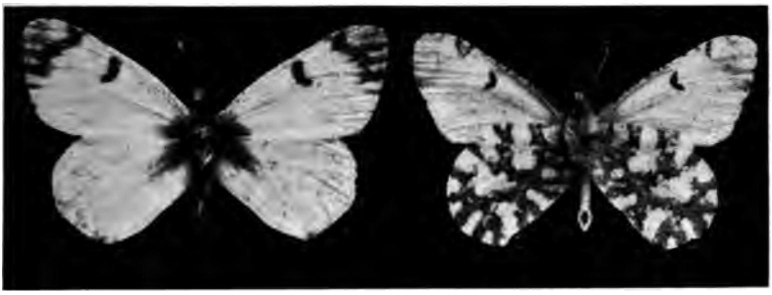


Fig. 30. Synchloe aussonides.

Butterfly—Fore wings greenish beneath; hind wings marked with three irregular green bands, the outer one forking into six or seven branches toward the outer and inner margins. Expanse ,1.65 to 1.90 inches, 41-48 mm.

Early Stages—Caterpillar pale whitish green, with dark-green longitudinal strips on the side and back. It feeds on cruciferous plants.

Distribution—It ranges from Arizona to Alaska, eastward to Colorado. Brandegee reports it common at Helena. It is one of the most abundant insects about Missoula in the spring, although not so abundant as **sara.**

THE SARA ORANGE-TIP.

Synchloe sara, Boisduval, Fig. 31.

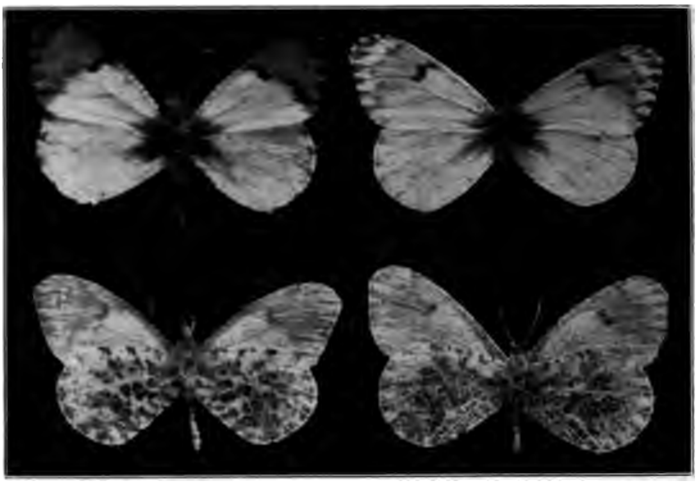


Fig. 31. **Synchloe sara,** upper and lower surfaces.

Butterfly—White with orange tips. There is a black bar dividing the apical patch. The female is sometimes yellow instead of white. On the under side the hind wings are marked with dark irregular patches of greenish brown scales, loosely scattered over the surface, and having a "mossy" appearance. There are different varieties.

Early Stages—Unknown.

Distribution—This species in all its forms belongs to the Mountain States of the Pacific Coast. It is abundant around Missoula, where it seems to thrive. The mountain slope back of the University is a favorite field, as it faces the west, catching the warm rays of the sun in spring. Here dozens may be captured in a short time. It is common around Helena (Brandegee) and about Bozeman (Cooley).

Var. **julia,** Edwards, in which the black bar dividing the red apical patch from the white on the remainder of the wing is broken, or tends to diminution at its middle, is reported by Brandegee as common at Helena.

Variety **reakertii** is smaller than **sara,** with dark spots at the ends of the veins of the hind wings. Taken by Brandegee at Mt. Ascension, near Helena.

THE OLYMPIA ORANGE-TIP.

Synchloe olympia Edwards. Fig. 32.

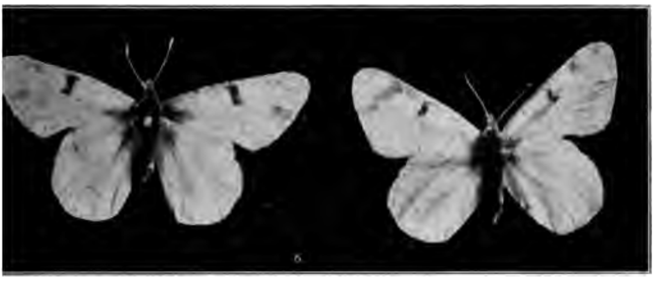


Fig. 32. Synchloe olympia.

rfly—Expanse. about 1.25 inches. Upper surface white, gray **f wings; a large gray patch at the apex of the fore wings, par- laced by white.** Costal margin slightly specked with black; **a r at the end of cell.** The hind wings have a few black scales **ter angle and a small wedge-shaped black spot near the base on .** Under side white. The fore wings have a small gray sub- **tch on the costa, nearly covered with green scales, and a faint patch on the outer margin.** Discal spot narrow, lunate, en- **white streak.**

rings crossed by bands of yellow-green on a gray ground. The the base is slightly trifid on the costa, the outer one broadly t running from the outer margin instead of the costa, the middle r one joined on the median vein. There is also a spot of the or between the anterior ends of the second and third.

black above, the under side white, the thorax tinged with yellow.

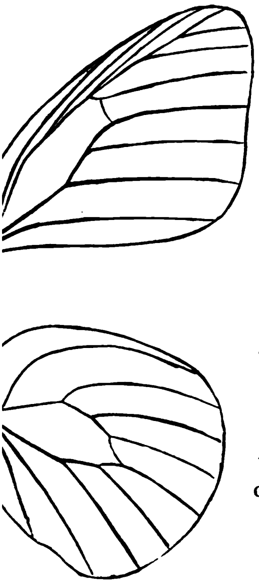
y Stages—The caterpillar is striped lengthwise with pale slate l bright yellow; feet, legs and head grayish green. The food e the cruciferous species.

ibution—Found from West Virginia to the Rocky Mountains, and ntana southward to Texas. In Montana collected abundantly by Miles City; taken by Cooley at Bozeman, and by Barnes at

Butterflies and Fairies.

Lily Mordaunt in "Kenelm Chillingly" had some beliefs that make her too fanciful for a real character. One of the most conspicuous of these was her idea about butterflies. She had a green-house inclosed with wire and covered with vines and draperies, into which she put every butterfly she could catch. Butterflies to her were not insects, but the souls of infants who had died unbaptized. If they were taken care of for a year they turned to fairies. So she fed and tamed her colonies of butterflies, releasing them when she believed their year of life completed, that they might be free to change into fairies.

NELLIE A. WHITNEY.



. 33. Venation of Eurymus.

GENUS EURYMUS, Swainson.

(The Sulphurs.)

Fig. 33.

Butterfly—Medium sized, yellow or orange in color, with black borders upon the wings. In many species this border is heavier in the female than in the male.

Egg—The egg is spindle shaped, thickest at the middle, tapering at the apex and at the base, generally attached by an enlarged disk-like expansion, to the point on which it is laid. The caterpillar feeds upon Leguminosae and especially upon the clover.

Distribution—This genus is represented throughout the temperate regions of both hemispheres. It also occurs in the cooler portions of South America and along the ranges of the Andes.

Key to Species.

1. Ground color of wings yellow, no black at base; underside with a sub-marginal row of dark points, philodice.

Ground color of wings orange, or at least an orange patch in the middle of fore wings.

Wings orange above and below, eurytheme.

Wings deep orange above, green below meadii.

Under side without sub-marginal row of black spots. Apex of fore wings and the entire surface of hind wings greenish gray, color generally white, scudderi.

Canary yellow, larger than preceding; ocellus on under side, hind wings white, alexandra.

THE COMMON SULPHUR.

Eurymus philodice Godart. Fig. 34.

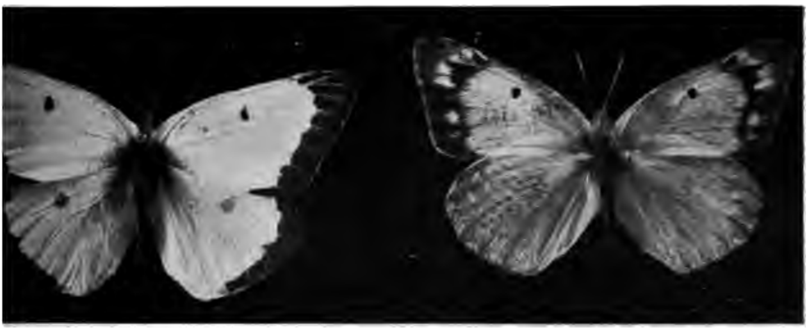


Fig. 34. Eurymus philodice, left figure, male; right female.

Butterfly—Wings above rather pale greenish yellow, outer borders black; border of female is broader than in male, and contains a submarginal row of yellow dots; discal spot in the male is elliptical; antennae, costa and fringes roseate; a submarginal row of dots on the under side, the last three on the fore wings black, the remainder brown with pink scales. Dimorphic females occur with wings nearly or quite white and also a black form. Expanse 1.75, 2.25 inches, 38-57 mm.

Early Stages—The food plant is clover. The eggs are pale yellow, changing after being laid to crimson. The caterpillar is slender, green, striped longitudinally with paler green. The chrysalis is pale green.

Distribution—The species ranges from New England to Florida and westward into the Rocky Mountains. The collection at the University of Montana contains specimens from Missoula, Fish Creek, McDonald Lake in the Mission Mountains, Lo Lo Hot Spings, Flathead Lake, Madison Valley, National Park and Mount Lo Lo.

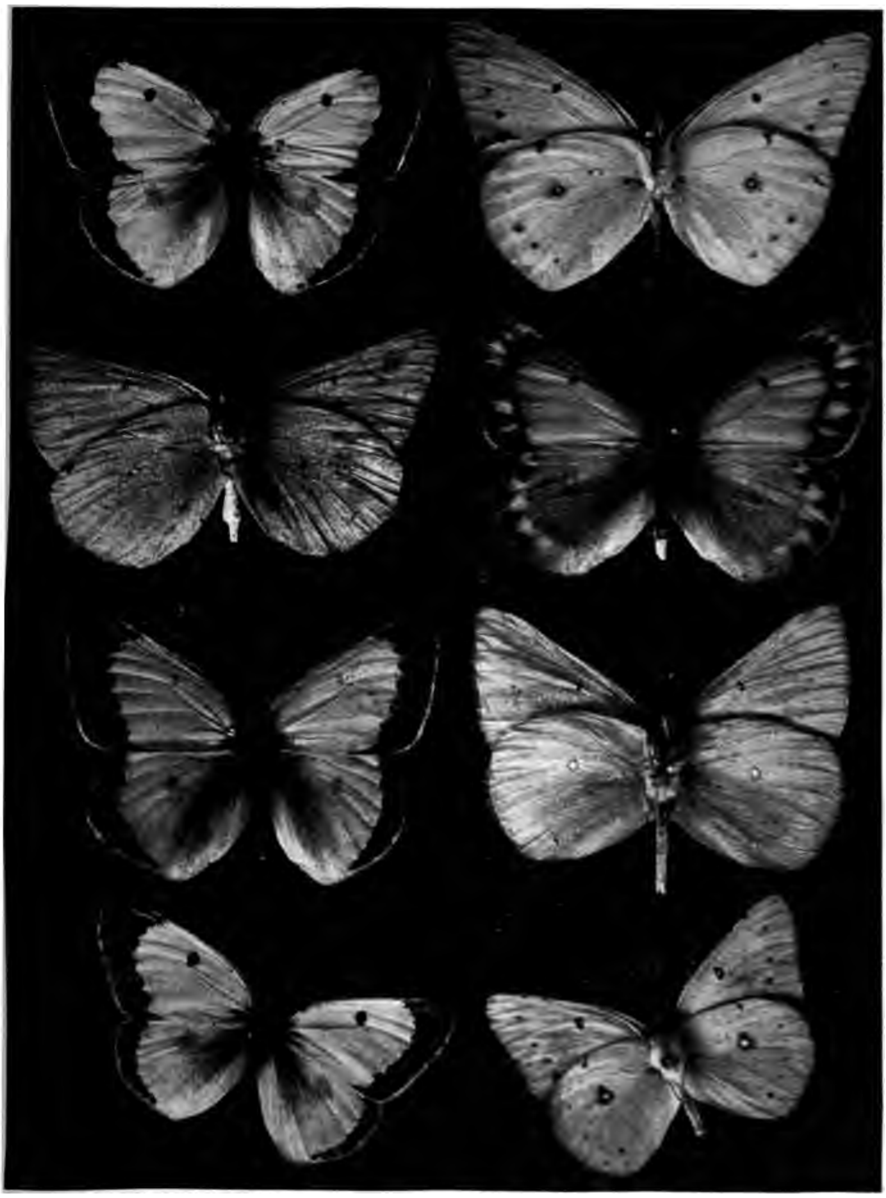
Remarks—It is one of our common butterflies. It shows many variations in size, coloration and markings. We have despaired of separating the males of philodice, eurytheme and alexandra, so much are they alike, and so much do they vary. It would at first seem as though phliodice should not be found west of the range, but specimens from Flathead Lake are indistinguishable from those in the eastern end of the state, and if the labels of Montana specimens were exchanged with those collected by Wiley and the writer from Iowa, Michigan, Illinois, and Missouri the difference could not be told. The large series (about 100) of insects of this species in the University collection shows that the species in markings and coloration apparently merges into Eurytheme, and it has often occurred to us that they may possibly overlap.

THE EURYTHEME SULPHUR.

Eurymus eurytheme, Boisduval. Plate IV.

Butterfly—Expanse of wings 2 to 2.35 inches, 50-90 mm. Closely resembling philodice in size, shape and markings, but color orange, of varying shades, instead of yellow. Male usually orange-yellow, shading to sulphur yellow on the costa of both wings and on inner margin of hind wings, base and inner margin sprinkled with black scales; outer border black, broadest at apex; anterior veins yellow where they cross the black; width of border about one-fourth the length of wing; discal spot black on fore wings, orange on hind wings, usually with two spots in the latter; both wings have roseate reflection; under side yellow, middle of fore wings tinged with orange; on both wings a sub-terminal row of dots, the three posterior of fore wings black, the remainder brownish, also two dots on costa near apex; discal spots repeated, the anterior black, with a few light scales, posterior gemmate, silvery, annulate with roseate brown or ferruginous; a dash on the costa of the hind wings near the apex, and a rosy spot at the base.

Female of same general color; border contains a row of yellow spots, the third from the posterior and on fore wings sub-obsolute; border of hind wings wider than in male, and with rudiments of yellow spots; under side similar to that of male.



Eurymus eurytheme, 3, under side; 4, upper side of female; 1, upper side of male; 2, lower side of female, form keewayden; 5, upper side of male; 6, lower side of female, form meadii; 7, upper side of male; 8, lower side of female, form ariadne.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

A white or albino female, Fig. 35, is sometimes found with all the markings as in the yellow form, white replacing the yellow. There are he following seasonal and local variations from the typical form.

Form **aridadne,** Edwards, Plate IV, emerging from winter chrysalis, has the fore wings tinged with orange, a spring form. Expanse, 1.75 nch, 45 mm.

Form **keewaydin,** Edwards, Plate IV. Larger than preceding, more deeply flushed with orange, a winter form. Expanse, 1.85 inch, 48 mm.

Form **eriphyle,** Edwards, yellow, not laved with orange, summer form. Expanse, 2.00 inch, 50 mm.

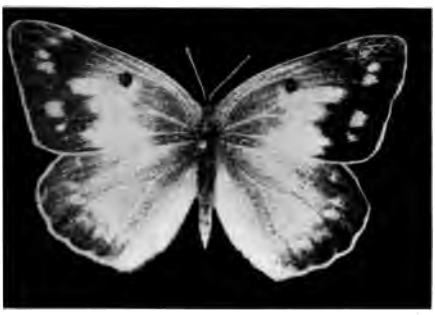


Fig. 35. Eurymus eurytheme, albino, female

Albinos have been taken at Flathead lake on the west side and at Fish creek east of the range, with expanse of wings 52-55 mm.

Early Stages—Egg .06 inch long, narrow, fusform, ribbed lengthwise, crossed by numerous striae; color buff-white when deposited, changing to crimson, then to black; mature larva from 1.1-1.2 inches, 26-28 mm. in length, dark green, with band of pure white, with crimon line; chrysalis with anterior part and wing cases dark green, abdomen yellow-green; the food plant is clover.

Distribution—The range of **eurytheme** is very wide. It extends from he Atlantic to the Pacific, and from Canada to the far south, though it is are in the south. It has been collected in the state by Elrod at Flathead Lake, Missoula, Mission mountains, Dodge Mountain at 7,400 feet, and Mount Lo Lo. Douglass has taken it at Fish Creek, Laurin, Ruby mountains, Tobacco Root range, and Madison valley; Wiley has collected it at Miles City, Brandegee at Helena and Gold Creek, and Cooley at Bozeman. It is found in all parts of the state, and will be one of the first specimens captured by the young entomologist. The reader is referred to "Remarks" under **philodice.** Coubeaux says form **eriphyle** is very common near Big Sandy. Allen has taken **eriphye, ariadne** and **keewayden** at Dillon. Coues collected **keewayden** and **eriphyle** along the the 49th parallel in 1874.

THE ALEXANDRA SULPHUR.

Eurymus alexandra, Edwards, Fig. 36.

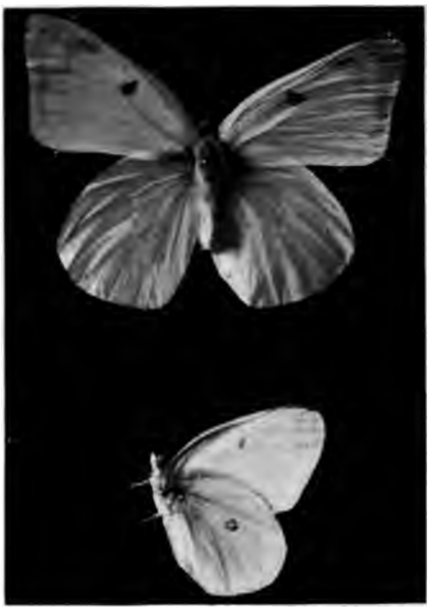


Fig. 36 Eurymus alexandra, female with expanded wings; male showing under side. From specimens taken at Bigfork.

Butterfly—Expanse of wings of females 2-2.3 inches, 50-60 mm.; of males, 1.75 inches, 45 mm. Male pale canary yellow, the black border much narrower than in **philodice** or **eurytheme**; a fine yellow line borders the black on outer margin; base of wings, thorax and abdomen with considerable black; anterior of thorax, antennae and legs roseate; under side of fore wings much paler than upper, uniform; under side of hind wings pale greenish gray, sprinkled with black scales; discal cell of hind wing silver, without rings; black border above showing through wing from below. Female larger than male, without black border above; sometimes the apex of fore wings is sprinkled with black, giving indications of markings; wings paler than in male, sometimes almost white; discal spot in fore wings black, oval, sometimes with yellow splash in the middle; on hind wing orange yellow, usually double; under side, silvery gray, yellow only at the base and on inner margin of the primaries; discal spot of hind wings silvery, with brown margin. Discal spot of fore wing dark brown with light spot in center; the roseate of the male repeated on the female, continuing around the outer border of the wings.

Early Stages—Caterpillar uniformly yellowish-green, with a white band on each side, broken with orange dashes running through it. The chrysalis resembles that of **philodice**, is yellowinsh green, darkest on the dorsal side, and adorned with three small red dots on the central side of the abdomen near the wing cases. The caterpillar eats **Astragalus, Thermopsis** and white clover.

Distribution—The species is found in Colorado and the Mountain region to the north and west of that state. In Montana it has been taken at the University of Montana Biological Station at Bigfork, in 1903, at Flathead lake. It is not common, and is rather difficult to catch, as it keeps to the bushes and does not rest often. Brandegee has collected it at Alhambra. A single frazzled and battered female was taken by Elrod on MacDaugal Peak in the Swan range at 6,500 feet August 4, 1903, and another August 1, 1904.

SCUDDER'S SULPHUR.

Eurymus scudderi, Reakirt.

Butterfly—Expanse, 1.80 to 2.00 inches, 45 to 50 mm. Similar to **alexandra.** The male on the upper side is colored like **C. pholidice,** but the black borders are much wider. The fringes are rosy. The female is generally white—very rarely slightly yellow—with very pale dark borders, or often without any trace of black on the outer margin of the wings. On the under side the apex of the fore wings and the entire surface of the hind wings are greenish gray. The discal spot of the secondaries is well silvered and margined with pale red.

Early Stages—The larva feeds on the leaves of the huckleberry and willow. Otherwise it is unknown.

Distribution—The species is found in Montana, Colorado, Utah, and British Columbia. Wilsey's collection contains one specimen from Miles City. We have not taken it west of the range.

STRECKER'S SULPHUR.

Eurymus meadii, Edwards, var elis Strecker. Plate IV and Fig. 37.

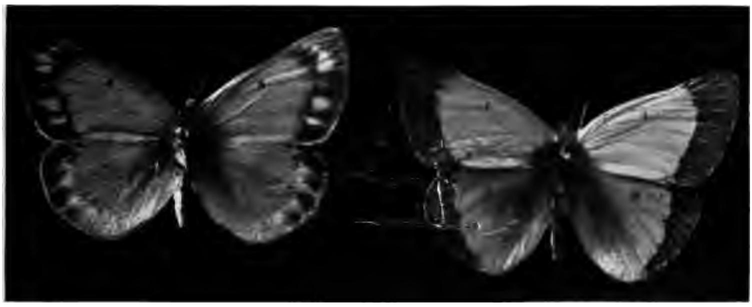


Fig. 37. **Eurymus meadii,** var. **elis,** left hand, female; right hand, male.

Butterfly—Expanse of wings 1.85 inches, 48 mm. Male; deep orange red above, with wide black border fringed with red; wing veins in both wings showing through black; black border covering outer third of fore wings, a little less of hind wings; fore wings black at base, extending to hinder angle of wings as a widening wash, ending in black scales over the orange ground; posterior edge of the hind wings with greenish gray from 2 to 3 mm. wide, bordered exteriorly by the black border above showing through; discal spots above deeper orange than ground color; below discal spot on fore wings small, dark brown; on hind wings light silver with red border; legs, antennae, anterior of thorax, hairs of head and fringe deep rose red; sometimes the outer anterior angle of the fore wings and the posterior angle of the hind wings above and below suffused with deep red. Female similar in general color to male, less pronounced and if anything lighter; discal spot on anterior wings black, showing through on under side; discal spot on hind wings similar to male; less black at base of wings; posterior edge of lighter color than in male; black border not so wide as in male, with dashes of much lighter orange than ground color; dashes suffused at anterior angle of hind wing; under side as in male; rose red antennae, thorax, head, legs, and fringe as in male.

Early Stages—Holland says "closely resembling those of meadii, of which it may be only a varietal form.

Distribution—It is recorded as inhabiting the lofty peaks of the Western Cordilleras. It has been taken by Douglass at Fish Creek, August 16, 1900, and in the Tobacco Root Range July 14, 1900.

Remarks—It differs materially from the meadii in the writer's collection taken at Pike's Peak in 1892. Elis as described above from Montana is larger in both sexes than meadii, has much less green, and with decidedly different washings of orange on the borders of the wings of the female. This female meadii has much more red in the ground color than in elis. The meadii were taken at 12,000 feet and elis at about 8,000 which would of course make some difference. We have taken neither meadii nor elis west of the main range.

Collecting Butterflies at High Altitudes in the Andes.

While forming these collections I was led to remark the frequency ith which closely similar forms recurred at similar altitudes, upon ountains often long distances apart. This was observed in regard to hings living in the soil, as well as in respect to winged insects of roving abits. It was not unusual to see butterflies, at closely similar altitudes pon widely separated mountains. This was the case with a **Lycaena** hat has not been described which was taken at 11-12,500 feet on ichincha and thirty-six miles away at 12,000 feet on Colocachi, and was ot seen elsewhere. But, for the most part, butterflies which were taken t considerable elevations were also found on the connecting, lower round. Thus **Pieris xanthodice**, Lucas, though captured so high as 4,000 and 15,000 feet, was found everywhere in the intervening basins; nd as, even had this not been so, it would need little effort for them to ass from one mountain to another, and further as they may sometimes uffer involuntary transportation, no particular stress can be laid upon uch instances of occasional recurrence at similar elevations.

One Butterfly, however, was exceptional in being found upon nearly ll the mountains visited, in numbers, and seemed to be established beween the elevations 12,000—16,000 feet. This is described by Messrs. oodman & Salvin, at p. 107 of the Supplementary Appendix, as **Colias lticola.** It was first obtained near Tortorillas, Chimboraza (13,000 feet), nd was seen in the Vallon de Carrel as high as 16,000 feet. When we ere camped upon Antisana it attracted attention by the great elevation bove the level of the sea at which it was flying (16,000 feet). It was een subquently upon all the mountains we visited (except Sara-urcu) between the elevations of 12-15,000 feet, and was captured at 12,000 feet on Pichincha, on 13,000 feet on Cayambe, and at 15,000 feet on the western side of Chimborazo, and was never either taken or seen in the basins between these mountains.

Whymper in "Travels Amongst the Great Andes of the Equator."

Family NYMPHALIDAE.

The Brush-Footed Butterflies.

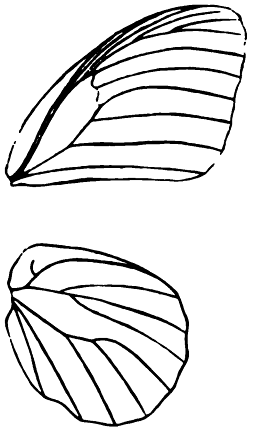


Fig. 38. **Venation of Nymphalidae, Argynnis leto.**

The family includes chiefly butterflies of medium or large size; but a few of the species are small. With a single exception, these butterflies differ from all others in our fauna, in having the fore legs greatly reduced in size in both sexes. They cannot be used for walking, but are folded on the breast like a tippet.

In the venation of the wings all of the branches of the radius of the fore wings are retained, this vein being five branched. (Fig. 38).

The caterpillars are, in most of the sub-families, provided with horny or fleshy projections. The chrysalids are usually angular, sometimes rounded. They always hang head downwards, supported only by the tail, which is fastened to a button of silk.

Five sub-families are represented in the United States, but three of the five in Montana. The following key will serve to separate them.

FAMILY NYMPHALIDAE.

Key to Sub-families.

1.	With some of the veins greatly swollen at the base	Agapetinae P. 105
	with none of the veins of fore wing usually swollen at the base	2.
2.	Antennae clothed with scales, at least above,	3.
	antennae naked	Euploeinae. P. 44
3.	Fore wings at least twice as long as broad	Heliconinae
	Fore wings less than twice as long as broad	4.
4.	Papli much longer than thorax	Libytheinae
	Palpi not as long as the thorax	Nymphalinae. P. 50

SUBFAMILY EUPLOEINAE.

Butterfly—Large butterflies; head large, antennae inserted on the summit, naked. The wings are rounded and somewhat elongated.

Egg—The eggs are ovate, conical, broadly flattened at the base and lightly truncated at the top.

Caterpillar—On emerging from the chrysalis, the head is not larger han the body. The body has a few scattered hairs on each segment. n reaching maturity the head is small, the body large.

Chrysalis—It is relatively short and thick, rounded, with very few rojections.

Key to Genera.

Palpi remote, not extending much beyond the head; discal cell of ind wings closed; a black spot on vein of hind wings of male. Anosia

Genus ANOSIA, Hubner.

Butterfly—Large seized, fore wings greatly produced at the apex.

Egg—The egg is ovate conical, ribbed with many cross-lines. The ggs are pale green in color.

Caterpillar—Cylindrical, fleshy, transversely wrinkled, with long, lender filaments.

Key to Species.

olor fulvous; veins black plexippus

THE MONARCH BUTTERFLY, Anosia plexippus L., Fig. 39.

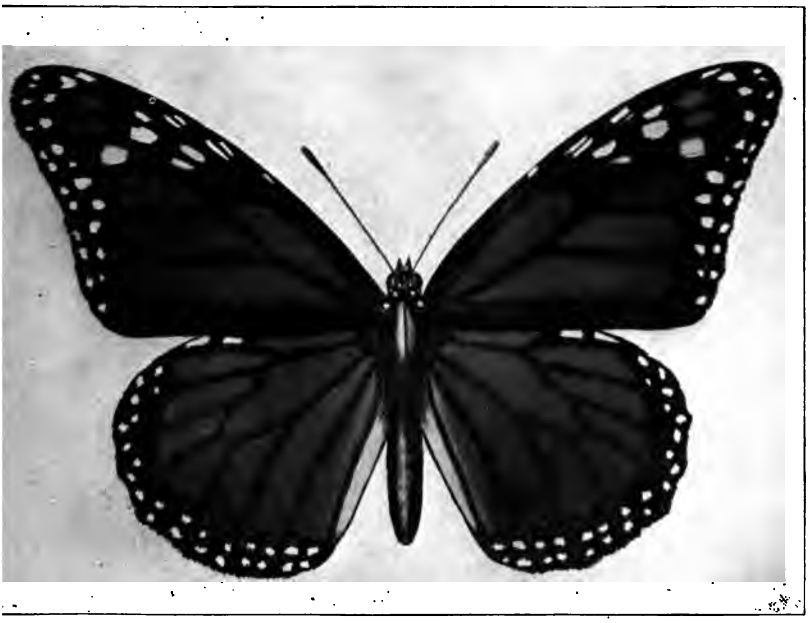


Fig. 39. **Anosia plexippus**, From water color by Mrs. Edith Ricker.

Butterfly—Expanse of wings 3.75-4.5 in., 96—114 m m. Upper surface tawny red or fulvous, with the veins heavily marked with black, a black terminal border containing two rows of white spots, a complete and partial row of white or lighter fulvous spots in a black space beyond the cell of the fore wings. The males have the wings less broadly bordered with black than the females, and on the first median nervule of the hind wings there is a black scent-pouch. Body black with white spots.

Early Stages—When first deposited the eggs are white, but in two or three days turn yellow, just before hatching change to dull gray. Somewhat conical in form, and marked by twenty-five ribs with the same number of transverse ridges. The young larva is yellowish white, with a large black head. The mature larva is about 1.75 in., 45 mm. long; the head yellowish marked by two triangular black stripes. The body is marked with transverse stripes of black. yellow, and white. It is furnished with black fleshy thread-like appendages.

Chrysalis—About 25 mm. long, pale green, spotted with gold. There are two or more broods in a season.

Distribution—United States generally. The collection of the U. of M. contains specimens from Missoula, the Ruby Mountains, and Miles City. Collected by Coues along the 49th parallel in 1874.

The Seasonal Migration of Anosia Plexippus.

The range of Anosia plexippus is from Patagonia to Hudson Bay.
has not been found in hibernation and, considering its size and con-
cuous coloring, it may well be said that it does not pass the winter
rth of latitude 31 degrees. A careful study of its range, time of
earance, and habits, shows unquestionably that there is a seasonal
gration of this very interesting form.

Riley first suggested these movements, when state entomologist of
ssouri, in the following words: "There is a southward migration late
the growing season, in congregated masses, and a northward disper-
n early in the season, through isolated individuals."

The more evident movement is in the fall, when in the Mississippi
lley and along the Atlantic Coast, the September air seems to be full
brown butterflies, usually apparently taking advantage of the cooler
nds from the North, though many times bravely beating into the winds
th a very strong flight for a butterfly. The Aster patches growing
ng the roadside and in neglected fields seem to be the favorite places
assembly. At such times a zoology class has no difficulty in provid-
g themselves with material. In fact an active boy with a net can
tch them by the hundred in one afternoon.

The collecting together of such numbers was formerly accounted for
the presence of plenty of food. This alone seems inadequate, since
ny fields, equally inviting, will contain a normal population. It seems
ely that a swarm may busy themselves in this way in the fields, await-
g favorable winds. We must pause to consider the probable absence of
tiative on the part of the insect. It is more likely influenced by the
nperature, the North wind being the cooler, and, for some reason not
lained, awakening in the insect the dormant instinct of migration.

An instance of the gathering of thousands of Anosia in one tree
the fact that they remained there with occasional short excursions,
il a change of wind and temperature, was noted in Burlington, Iowa,
last week of September, 1905. The fact that these insects alight
rees in such swarms as to give their color to the tree, has been often
rded. This is not the only evidence of their flocking. There is the
t of authority for stories of southward migration. Some have re-
ed clouds so dense as to at times cast a shadow. Dr. Scudder re-
s a flight on September 2, in New Hampshire, when the southward
nt of a swarm was observed by himself. He states that they
tched out in a thin stream that occupied hours in passing. He esti-
ed that in a limited field in front of him, they were passing at the
of 1,500 per hour. It is little wonder that they are said to fill a
, bending the twigs to breaking with their weight. Granting that
se accounts of large numbers of Anosia in one swarm are exceptional,
can see that spread over this broad land there must be countless mil-
ns moving southward every autumn. What advantage, if any, is
ned in the association of these insects in swarms, is not easily dis-
ned.

The fact of Northward movement in the spring is not so easily established. As before stated the Anosia is not reported to have been found North of latitude 31 degrees in the winter. When Spring opens neither the egg, pupa or adult is to be found. The milkweed is a foot high in Iowa and much good fodder is awaiting the larvae, before the adult makes its appearance, and lays eggs on the tender unfolding leaves near the tip of the growing plant. Some say that the appearance is not that of a tattered "left over," as is usually the case with hibernating species. They appear as a whole to be a fresher and newer lot; though I have seen some that looked a good deal the worse for wear rather early in the season. There seems little doubt, however, that the new arrivals have not hatched in our region, since there has been no opportunity for larvae to develop and pupate. It seems more probable that they are the spring brood from an earlier season in the south. We must not, however, confuse them with those that disappeared in that direction last fall.

In Southern Iowa it seems probable that the eggs laid by the first arrivals produce a new brood in July. These in turn produce the brood that soon after arriving at maturity southward. We seem to have two broods; while New England and northern climes have one only, and that one, from the eggs of the first brood hatched in our latitude. The northward migration is continued to Hudson Bay and north of the range of the food plant of the larvae; a significant fact, in itself, proving the migration of the species. The northern boundary of the food plant limits the adult of other species sharply. This is noticeably the case with Papilio ajax in southern Iowa, where a species very abundant south of us is limited by the food plant, the Pawpaw, which disappears near the 40th parallel.

There are several known peculiarities of this insect that especially fit it for this sort of a life. The well known immunity from molestation by insectivorous birds, the comparatively long intervals between oviposition, enable a butterfly of this species to scatter its progeny over a great territory, since but one egg is laid in a place. The slow northward movement of the season in spring allows time for additional broods further South. The adults that first arrive here in the spring are supposed to be from larvae grown several hundred miles to the southward, where there may be four or more broods in one season. This northward movement may therefore be considered a sort of a relay race. The returning hosts contain none of the brood that came northward, since the life of an insect after final oviposition is usually short and its excuse for existence has expired.

Granting that the seasonal migration of this butterfly is established, we may say that this is merely another way in which nature replenishes the earth after the life destroying frosts of winter, so fatal to insect life. Hibernation has its advantages, and does not call for so complex an adaptation. Why Anosia has this different means of preservation is as much a puzzle as ever. This illustrates anew a striking observation by Mr. Frank Springer, the paleontologist, when sepaking of the marvelous perfection to which an organism may be brought through a period of development, only to be apparently discarded and the whole problem worked out in an entirely different way in succeeding forms. He says t seems as though Nature delights to show in how many different the same result can be accomplished." In this case, it seems as the combination of the striking adaptations of Anosia have made nd only to the Pieris rapae, or "cabbage butterfly", in numbers stribution over the earth.

recent times this insect has spread to Australia, and from there the East Indies and the Philippines. It is captured in Europe ncreasing frequency, and will doubtless be as successful in the old as in the new. It is a harmless species and will not prove as unne as has the little white pest in this country. We may wish it s in its efforts to colonize the East, and fear no reports of misor to discredit the benefits to be derived from New World exn. As a rule we have given them few plants and animals that nerited their disapproval. The Phylloxera is a notable exception, it threatens the vinyards of the Old World. On the other hand n hardly name a weed or obnoxious animal in this hemisphere that t been imported to our country. At all events the behavior of will be watched in the Old World with a growing interest to see ll there develop any new and interesting traits.

MAURICE RICKER.

gton, Iowa, September, 1905.

SUBFAMILY NYMPHALINAE.

The Nymphs.

Butteryfly—The butterflies of this subfamily are mainly of moderate or large size, though some of the genera contain quite small species. The antennae are always more or less heavily clothed with scales, and are usually as long as the abdomen, and in a few cases even longer.

It is impossible to briefly describe these butterflies because they vary so much. It is the largest of the subfamilies.

Key to Genera.

1. Palpi nearly connivent, porrect 2.
2. Eyes naked 3.
    Eyes hairy 13.
3. Club of antennae short, ovoid, usually flattened in dry specimens 4.
    Club of antennae obconic or generally terminating in a knob. 12.
4. Outer margin of fore wings sinnous.
4a. Upper surface with eye spots, Euptoieta, P. 51
    Upper surface without eye spots, Speyeria, P. 52
    Outer margin of fore wings not sinnous 5.
5. Large or medium size; cell in secondaries closed or open 6.
    Small cell in secondaries open 10.
6. Color of both wings fulvous, with silver spots 7.
    Fore wings fulvous, hind wings black Semnopsyche.
    Color of both wings fulvous, without silver spots 9.
7. Two innermost sub-costal nervules arise before or at the end of the cell 8.
8. Branch to the median vein of the front wings Argynnis, P. 54
    No branch to the median vein of the front wings 9.
9. Only one sub-costal nervule vein arises before or at the end of the cell Brenthis, P. 69
10. General color fulvous or black Lemonias, P. 72
    General color fulvous, with a prominent black border; no silver spots on the under side 11.
11. Under side of hind wings brownish or brownish yellow Phyciodes, P. 78
12. Hind wings not tailed; ground color black, fulvous or mahogany brown Basilarchia, P. 102
13. A golden or silver spot on under side of hind wings Polygonia, P. 84
    No golden or silver spot on under side of hind wings 14.
14. Apex of fore wings somewhat truncate, the angles rounded Vanessa, P. 98
    Apex of fore wings distinctly truncate, the angles sharp 15.
15. Ground color deep fulvous or brown; black bar across the cell of fore wing; black border or submarginal band Eugonia, P. 90
    Ground color maroon brown, out margin yellow, supplemented by a row of blue spots Euvanessa, P. 96
    Ground color brown, submarginal band fulvous Aglais, P. 97

THE VARIEGATED FRITILLARY, Euptoieta claudia, Cramer.

Fig. 40.

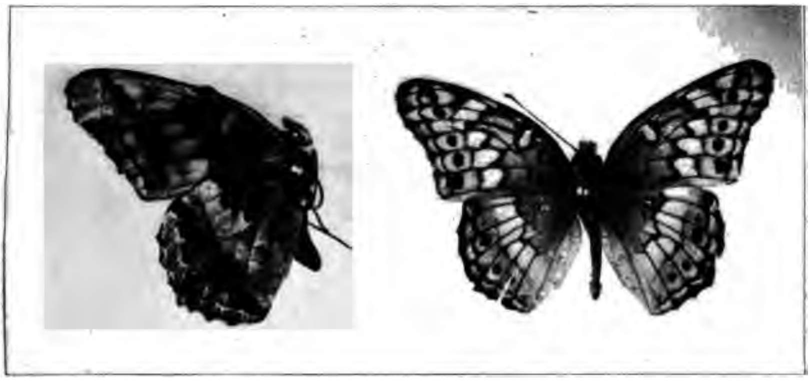


Fig. 40. **Euptoieta claudia,** from Miles City, showing upper and lower surfaces.

Butterfly—Expanse of wings from 1.75 to 2.75 inches, 45-70 mm. Upper side of both wings fulvous or dull ferruginous, darker toward the base, crossed by an irregular black median line, which is darker, broader, and more zigzag on the fore wing than on the hind wing. This line is followed outwardly on both wings by a pair of more or less blackish spots. The outer margin is black, fringes pale fulvous, checkered with black at the end of each nervule. At the end of the cell in the fore wing there are two black lines inclosing paler fulvous spots, and both wings near the base have some curved black lines.

Under side of fore wings fulvous to the zigzag line, with discal pale spot. The outer half of the wing is pale, with a little submarginal reddish wash below the apex, and a large gray triangle on the costa. A brown spot near the posterior angle sends a marginal streak toward the apex.

The hind wings are pale brown in the basal half, streaked with white along the veins, and with transverse striae of darker brown. Beyond the middle they are whitish, shading off into the same brown as the base, with more or less whitish along the margin, the anal portion of the outer half being nearly as dark as the base, while the costal portion is almost white. There are about three indistinct marginal ocelli.

Early Stages—The egg is conoidal, depressed at top, flat at base marked by about twenty longitudinal ribs, half of which reach the summit. Mature larva is 1.2 inches, 28 mm., cylindrical, of an orange ochre color, smooth, striped longitudinally with black, which is almost concealed by the white spots that cover it. The chysalis is .8 inch, 21 mm. long, pearl white, irridescent, marked with dark brown patches and points. On the abdomen there are four rows of conical tubercles. There are two or three broods during a season, the last one probably hibernating in the larval state. It feeds on violet, passion flower, mandrake, Sedum, Desmodium, and Portulaca.

Distribution—The species has been taken as far north as Long Island and Connecticut, though it is a rare visitor in New England; it is quite common in Virginia and thence southward, and occurs not infrequently in southern Illinois and Indiana, ranging westward and southward over the entire continent to the Isthmus of Panama, and thence extending over the South American Continent, wherever favorable conditions occur.

In Montana it has been taken by Cooley at Forsyth and in Gallatin County, and by Wiley at Miles City. At the latter place it is common, but averaging smaller in size. The species seems to be confined to the Great Plains region of the state, although later collections may show it farther west than it seems from present records to be.

THE REGAL FRITILLARY.

Speyeria idalia, Drury. Fig. 41.

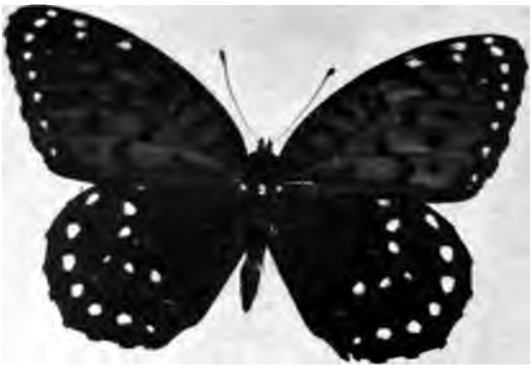


Fig. 41. **Speyeria idalia, Drury.**

Butterfly—Expanse of wings from 2.75—3.6 inches, 70-90 mm.

Male. Upper surface of fore wings fulvous, black along the costa, with a black outer border which is a little wider than the costal border; base and hind margin brown; three black bars in cell, another bar at the end with an open S united to it enclosing a fulvous spot; beyond the cell runs a transverse zigzag line, a submarginal row of black dots, and next the border a row of black crescents. Hind wings black, with violet reflections; base of wings washed with fulvous; a black spot in cell, an irregular row of yellowish spots beyond cell, and a marginal row of fulvous spots; fringes alternate spots of black and white. Under side of fore wings fulvous, white along the costa, a marginal row of silver spots enclosed in black crescents, and some silver on the costa near the apex; black of upper side repeated; under side of hind wings yellowish brown, with twenty-nine silver spots and patches, besides some silver shading.

Female differs from male in being larger, with broader terminal band, which contains a row of white spots, witn six or more white spots near the apex, the outer row of spots on the hind wings of same color as the inner.

Stages—Egg conoidal, truncated, rounded at base, marked ver-
h eighteen ribs. Larva hatches in about twenty-five days. Larva
y 1.75 in., 45 mm., long, velvety black, banded and striped with
low changing to dull orange or red, and furnished with six
eshy spines, each with several black bristles; head red above
beneath. Chysalis an inch long, brown and yellow on ab-
mainder pinkish brown or brown. The larva feeds on violets.
aphical Distribution—Wiley has collected it at Miles City. It
orted from other places, and the Wiley collection has but a
cimen. It is reported as common from Maine to Nebraska. It is
cted the species would be found in the eastern end of the state.
tern states it is rather local, and frequents open spots on the
woodlands. At times it is apparently common, and then for a
of seasons is scarce. It flies from the end of June to the be-
September.

THE FRITILLARIES. THE SILVER SPOTS, THE ARGYNNIDS.

Genus Argynnis. Key to Species.

1.	Under side of wings with silver spots	2.
	Under side of wings without silver spots	6.
2.	Basal half of wings fulvous brown, strong colored sub-marginal band	leto, P. 56
	Less than half the wings brown	3.
3.	Under side of hind wings with a light sub-marginal band	5.
	Under side of hind wings without a light sub-marginal band	4.
4.	Under side hind wings brown	aphrodite, P. 57
	Under side hind wings olive green	9.
5.	Under side of hind wings light brown	aphrodite, P. 57
	Under side hind wings maroon	atlantis, P. 63
	Under side apex fore wings buff, base pale cinnamon red	electa, P. 63
	Under side hind wings apex buff, mottled with green	eurynome, P. 64
	Under side hind wings basal two-thirds reddish brown, size large,	cybele, P. 54
	Under side hind wings deeply ferruginous	bremneri, P. 62
	Under side hind wings dark reddish brown	rhodope, P. 62
6.	Under side of hind wings ferruginous	7.
	Under side of hind wings greenish	8.
7.	Spots yellowish white	hesperis, P. 61
8.	Spots dull green,	eurynome, var. artonis, P. 65
	Spots dull green ,dark at outer edge,	eurynome, var. clio, P. 65
9.	Under side hind wings olige green	
	Ground color green, spots large	edwardsii, P. 59
	Ground color yellow and buff	nevadensis, P. 60

THE GREAT SPANGLED FRITILLARY.

Argynnis cybele, Fabricius, Fig. 42.

Butterfly—The expanse of wings of specimens in the eastern states is from 3 to 4 inches, or 76 to 102 mm. Upper surface fulvous or yellowish brown, more yellowish in the male than in the female. In the cell of the fore wings five black bars, except in the fourth bent outward in the lower half, the two outer united above. Beyond the cell are the usual zigzag black line and the subterminal row of dots, the middle ones of the fore wings the largest. Just within the outer margin is a termnial narrow line, and within this, and on the fore wings with their points resting on this line, is a row of crescents; the fore wings edged with the same color. The cell of the hind wing with three more or less distinct bars.

Under side of fore wings pale yellowish brown, the apical space yellowish and enclosing a bright brown costal patch; the lines and dots the same as above, but near the apex more brown. The apical five or six of the spaces enclosed within the submarginal crescents are wholly or partly silver, with three silver patches within this line.

The hind wings have the basal two-thirds reddish brown more or less mottled with yellow, the outer boundary of this color a row of seven silver spots. Outer margin brown, fading into yellow at the anal angle, and within this another row of seven large silver spots rounded within and edged with brown. Between these two rows is a bright yellow band without spots.

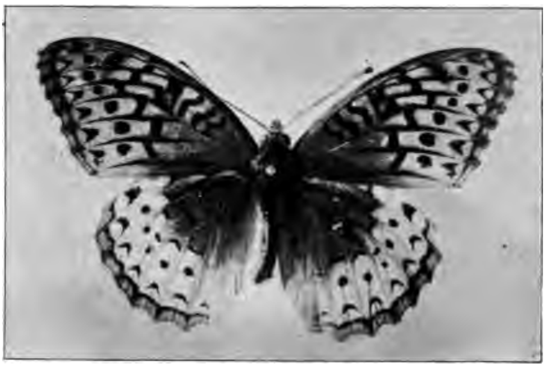


Fig. 42. Argynnis cybele.

Early Stages—The egg is short, conoidal, ribbed like those of other species, and honey-yellow. The larva in mature state is 1.8 to 2 inches long, velvety black, chocolate-brown underneath. The body has six rows of slender black spines, generally ornamented with orange red at the base, and beset with many short black bristles. The caterpillar is nocturnal, and feeds on violets. It hibernates immediately on hatching from the egg, feeding to maturity the following spring. The chrysalis is dark brown, mottled with reddish brown or slaty grey.

Distribution—It is from the Atlantic westward to Nebraska. Barber, 1894, reports it from the northwestern part of Nebraska. It has been taken at Edmonton, B. C., where it was found flying with **A. lais** by Captain Gamble Geddes, in 1883. A single specimen is in the Wiley collection from Miles City. taken June, 1900. It is a trifle less than three inches expanse, and placed side by side with specimens from Michigan, Ohio, and Illinois is indistinguishable from them. It has been taken at no other place in the state, and only the one specimen has been taken at the present writing.

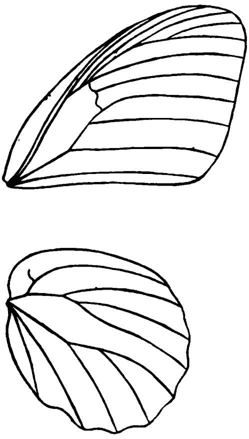


Fig. 43. Venation of Argynnis leto.

THE LETO BUTTERFLY.

Argynnis leto, Edwards. Figs. 38, 43, 44, 45.

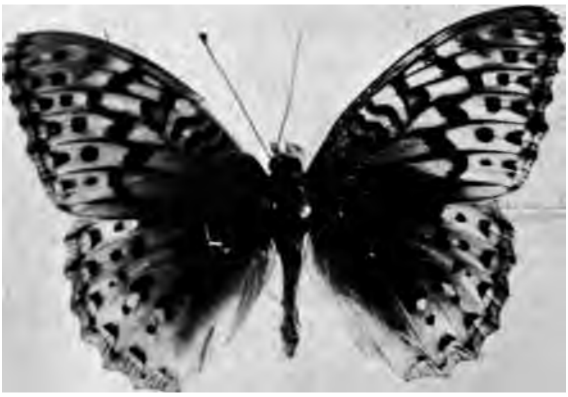


Fig. 44. **Argynnis leto, male.**

Butterfly—The male on the upper side is a dull fulvous with the characteristic black markings of the genus; the basal area is darker. The under side of the fore wings is plae fulvous upon which the markings of the upper side reappear. Both wings on the under side, are shaded with brown toward the base; the hind wings are traversed by a sub-marginal band of light straw yellow. The female is marked as the male, but the general color is pale straw yellow, and all the darker markings are deep blackish brown, those at the base of both wings being broad and running into one another, so that the inner half of the wings appear to be broadly brownish black. On the under side it is also marked the same as the male, but with the dark portions blacker and the lighter portions pale yellow. The marginal row of light spots on the hind wings appears on the under side as silver crescents; there are three rows of silver spots on the brown part of the wing. Expanse 2.50 to 3.25 inches, 64 to 83 mm.

Early Stages—Unknown.

Distribution—It occurs in California, Oregon and Montana. In Montana it is found on both sides of the mountains. In the western part it is abundant about Flathead lake. It is a beautiful insect, demanding the attention of the collector, frequenting the more open woods, skirting the bushes by the roadsides, or frequenting the sunny open places in the woods. It has been taken, in addition to that mentioned, at Mount Lolo, Missoula, the Mission Mountains, and the Yellowstone Park by Elrod, at New Chicago by Douglass, at Helena by Brandegee, and at Miles City by Elrod. A male was collected at Miles City in July, 1893, and a female in Yellowstone Park in September, 1894, both identified by Edwards. It is likely to be found in most parts of the state, and will ornnament any collection. Allen reports a female **nokomis** from Dillon. I have not seen the specimen, but think it may be **leto.**

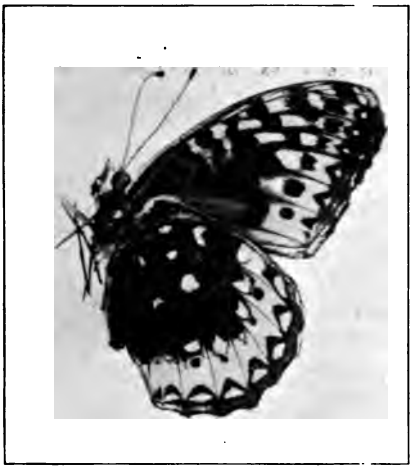


Fig. 45. **Argynnis leto,** female.

THE APHRODITE FRITILLARY.

Argynnis aphrodite, Fabricius. Figs. 46, 47.

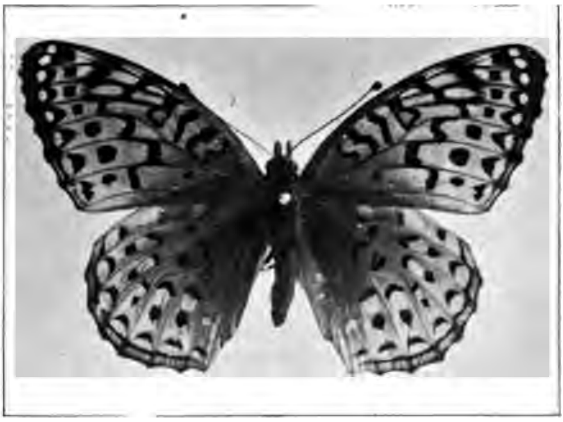


Fig. 46. **Argynnis aphrodite,** var **alcestis,** upper side.

Butterfly—Expanse 2.25 to 3 inches, 57-76 mm. Upper surface of wings bright reddish fulvous; the basal third of both wings washed with cinnamon brown. The black markings similar to **cybele** and **leto.** The median zigzag line is often broken. The two lines at the outer margin of the female are more or less blended, and the two are present on the hind wings of both sexes. The under side of the fore wings is pale reddish fulvous, the apical portion and along the costa buff, with pale brown markings; six marginal and three sub-marginal silver spots. The hind wings are cinnamon brown with a narrow sub-marginal band. The silver spots are more or less edged with black.

Early Stages—The eggs are short, conoidal, honey yellow and ribbed. The caterpillar has a velvety black spot at the base of each spine, the chrysalis has the tubercles on the back short, and the basal segments are partly colored. The caterpillar feeds on violets.

Distribution—It is found in the northern and middle western states. Taken in the state by Wiley at Miles City, and by Elrod at Missoula. Cooley has one specimen from near Bozeman at 4,200 feet, July 20. Coubeaux reports it common in Bear Paw Mountains.

Var. **alcestis**, Edwards, Fig. 47, the Ruddy Silver-spot is very much like aphrodite, but distinguished from it by the fact that the hind wings are uniformly dark cinnamon brown, without any band of buff on the outer margin. It is of the same expanse as **aphrodite**. It is said to largely replace **aphrodite** in the western states. Indeed, there is likely to be difficulty in separating **alcestis** from the true form of **aphrodite**.

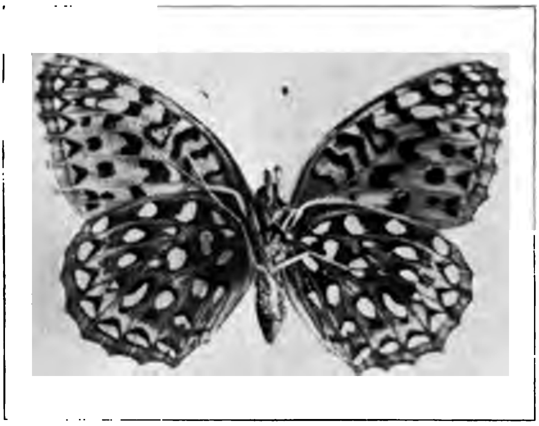


Fig. 47. **Argynnis aphrodite**, var. **alcestis**, lower side.

Alcestis has been taken by Elrod at Missoula and Flathead Lake, by Douglass in the Madison valley. The latter closely resemble **aphrodite** from Miles City. By far the greater number of specimens examined are **aphrodite**, and not var. **alcestis**.

EDWARDS FRITILLARY.

Argynnis edwardsii Reakirt, Fig. 48.

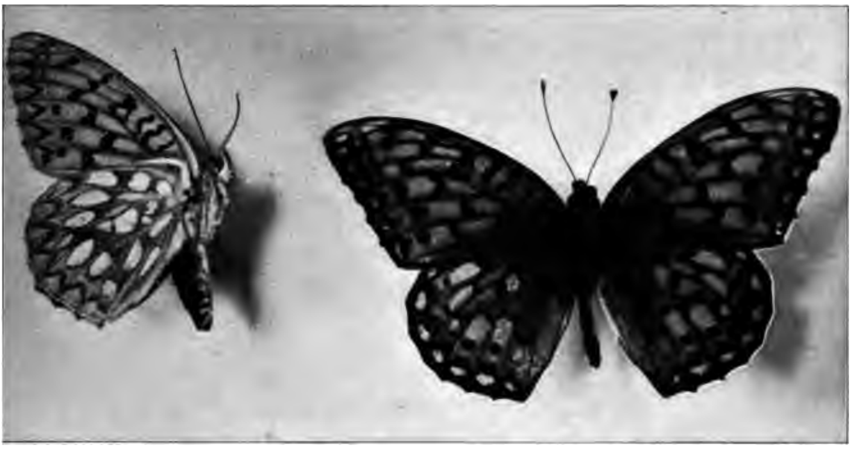


Fig. 48. **Argynnis edwardsii**, upper and lower surfaces.

Butterfly—Expanse of wings 2.30-3.00 inches, 55-75 mm. Ground color pale fulvous, but little obscured with fuscous at base; a heavy black border at base; at least heavier than in **nevadensis**; lighter buff than **nevadensis**, under side of hind wings with large silver spots, olive brown color; the olivaceous of the wings encroaches on the marginal band. It may be known by its large size, by the long and pointed fore wings, and by the great size of the silver spots that ornament its under side.

Distribution—According to Holland the species is not uncommon in Montana and Colorado. In Montana it has been taken by Wiley at Miles City, Douglass at New Chicago, and Fish Creek. Collected by Coues in 1874 on Chief Mountain.

Remarks—Attention was called in the introduction to specimens identified by Edwards. One specimen sent by Wiley and another by Elrod from Miles City in different years were identified respectively as **nevadensis** and **edwardsii**. When placed side by side they are indistinguishable either in size or markings. Larger specimens from low elevation are likely to be called **edwardsii**, smaller ones from higher elevation **nevadensis**. We believe that experiments in breeding will show the two species to be one.

THE NEVADA FRITILLARY.

Argynnis nevadensis, Edwards, Figs. 49, 50.

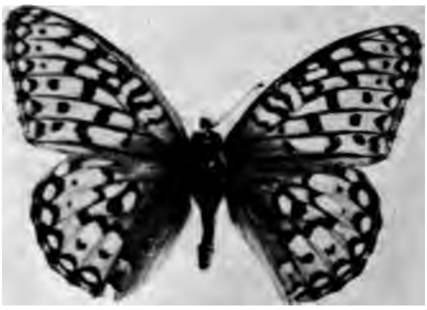


Fig. 49. **Argynnis nevadensis,** upper side.

Butterfly—Expanse of wings, male, 2.50-3.00 inches, 63-75 mm.; female, 3.00-3.50 inches, 75-88 mm.

The ground color is pale fulvous, but little obscured with fuscous at the base. The outer margins are heavily bordered with black. The dark markings of the discal area are not heavy. The fore wings on the under side are pale buff, the spots well slivered; the hind wings are greenish; the belt is narrow and clear, and the spots are large and well slivered. The female is much like the male, but larger and paler. The outer margin of the fore wings in the female are more heavily marked with black and marginal spots are light buff in color.

"It is allied to Edwardsii in shape, and forms a sub-group with it. It is brighter colored, smaller sized, and beneath the ground color is yellow and buff, mottled in the male with pale olive-green, and in the female with darker buff" (Edwards).

Distribution—This species is found in the Rocky Mountains of Utah, Nevada, Montana, and British America. Specimens have been taken from Tobacco Root range by Douglass; Missoula by Elrod; Swan Range, 7,600 feet, by Elrod; Lolo Hot Springs by Elrod; Mount Ascension near Helena, by Brandegee; Shields river, 9,000 feet, Gallatin Valley, East Flathead, Park county, by Cooley. It thus ranges from 3,200 feet to 9,000 feet altitude. Collected by Coues in 1874 at Three Buttes, August 8

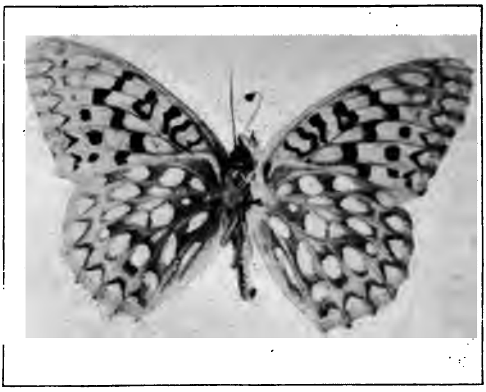


Fig. 50. **Argynnis nevadensis,** lower side.

THE HESPERIS FRITILLARY.

Argynnis hesperis, Edwards. Fig. 51.

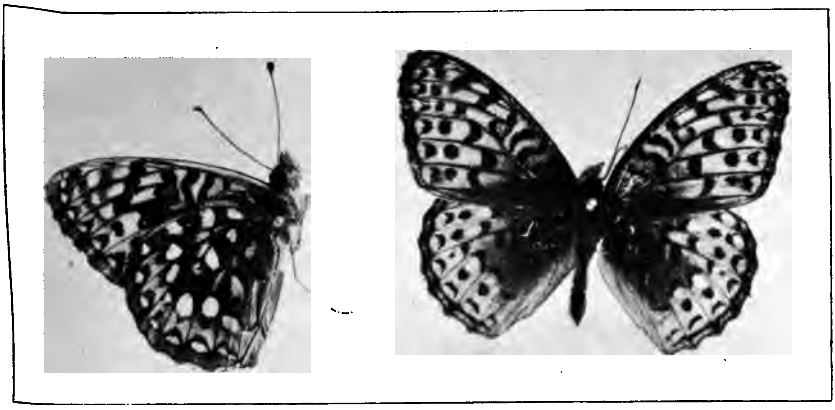


Fig. 51. **Argynnis hesperis,** upper and lower surfaces.

Butterfly—The male on the upper side of the wings is fulvous, shaded with dark fuscous for a short distance from the base. The black spots of the median band are rather broad, and seem to coalesce through dark markings along the nervules. The under side of the fore wings is pale ferruginous, tinged with a little buff at the tips. The under side of the hind wing is dark ferruginous with a narrow buff sub-marginal band. Ground color of the female is paler than the male. In neither are the light spots marked with silver; they are opaque, yellowish white. Expanse, 2.25-2.40 inches, 57-61 mm.

Early Stages—The life history remains to be learned.

Distribution—The butterfly is found among the mountains of Colorado and Montana.

It has been taken by Elrod in the National Park, at Missoula, in the Swan Range, and on Mount Lolo near Missoula. Cooley has a specimen from Bozeman at 4,800 feet. Brandegee collected it near Helena, and Barnes at Aldridge. Rare in the Bear Paw Mountains, according to Coubeaux.

THE RHODOPE SILVER-SPOT, Argynnis rhodope, Edwards.

Butterfly—Expanse, male, 2.20 inches, 55 mm.; female, 2.40 inches, 60 mm. The upper side of the male is bright fulvous, both wings on the inner half heavily clouded with dark fuscous. The black markings are very heavy and confluent. The outer border is solid black, very slightly, if at all, interrupted by a narrow marginal brown line, in this respect resembling **atlantis**. On the under side the fore wings are dark ferruginous, on the outer margin rich dark brown. Between the spots at the end of the cell and the nervules below the apex are some clear, bright straw-yellow spots. The upper spots of the marginal series are silvered. The hind wings are dark reddish-brown, very slightly paler on the line of the marginal band. The spots are pale straw-yellow, except those of the marginal series, which are distinctly silvered. The female on the upper side is of a lighter and brighter red, with the markings dark and heavy as in the male sex. On the under side the markings in the female do not differ from those in the male, except that the primaries on the inner half and at the base are bright pinkish-red (Holland).

Early Stages—Unknown.

Distribution—The insect flies in British Columbia. Coues collected a single female August 8, 1874, near Three Buttes, Montana. This is the only record of its capture in the state.

BREMNER'S SILVER-SPOT.
Argynnis bremneri, Edwards. Fig. 52.

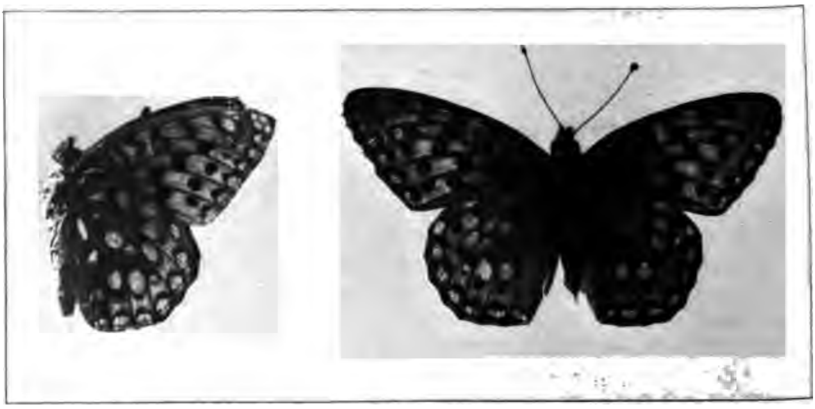


Fig. 52. **Argynnis bremneri.**

Butterfly—Expanse, 2.4 to 2.7 inches, 60 to 70 mm. The male on the upper side is bright fulvous. The black markings, especially those about the middle of the wings, are heavy. Both wings at the base are clouded with fuscous, the under side of a primaries red toward the base, buff on the apical area; the sub-apical and the upper marginal spots well silvered; the hind wings with the inner two-thirds more or less deeply ferruginous, a little mottled with buff, very rarely encroached upon by the dark color of the inner area, except occasionally near the angle (Holland).

Early Stages—Undescribed.

Distribution—Found in Oregon, Washington, Montana, southern portions of British Columbia and VanCouver's Island. Specimens in the University of Montana collection from Flathead lake by Elrod, and from Tobacco Root Mountains by Douglass. The specimens show the under side of lighter color than from Vancouver, but with the characteristic heavy black markings.

THE ELECTA SILVER-SPOT.

Argynnis electa, Edwards.

Butterfly—Expanse, 2.00 to 2.25 inches, 51 to 64 mm. The male is dull-reddish fulvous on the upper side. The black markings are narrow. The base of both wings is slightly obscured. On the under side the fore wings are pale cinnamon-red, mottled on the disk with a little buff. The sub-marginal band is buff, quite narrow, and often invaded by the ground color of the inner area. The silvery spots are usually very well marked and distinct, though in a few instances the silvery color is somewhat obscured. The female has the black markings a little heavier than the male; otherwise there is but little difference in the sexes (Holland).

Early Stages—Unknown.

Distribution—Among the mountains of Montana and Colorado. Holland says it is often confounded with atlantis, but is wholly distinct, smaller in size, the fore wings relatively broader, and the markings not so dark on the upper surface. We have not taken it.

THE MOUNTAIN SILVER-SPOT.

Argynnis atlantis, Edwards. Fig. 53.

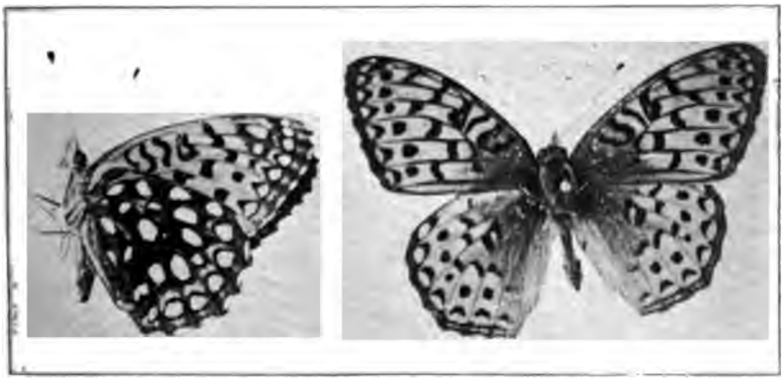


Fig. 53. **Argynnis atlantis,** upper and lower surfaces.

Butterfly—Expanse of wings, 2.25-2.50 inches, 55-65 mm. Upper surface fulvous, obscured by brown scales on the fore wings from the second bar in the cell obliquely to below the median zigzag line on the hind margin; the two marginal lines so blended that not much of the ground color is left. Marks as in **A. aphrodite.** Under side of fore wings reddish fulvous, costa and apex light buff, the apical patch and outer margin brown, with the apical silver spots, six marginal, three sub-marginal; hind wings dark red brown, much mottled with greenish gray or drab, the sub-marginal band pale yellow, usually pure from margin to margin. Silver spots as in **aphrodite.**

This insect resembles **aphrodite;** it is distinguished from that species by its smaller size, its somewhat narrower wings, the deeper color of the base of the wings on the upper side and their darker color on the under side. The sub-marginal band is pale yellow, narrow, but distinct and always present.

Early Stages—The egg is conoidal, with twelve to fourteen ribs, honey yellow. The caterpillars are hatched in the fall and hibernate without feeding until the following spring.

Caterpillar—The head is dark blackish brown. The body is velvety-purple above, a little paler on the underside. The usual spines occur on the body, and are black, grayish at the base. The larva feeds on violets.

Crysalis—Light brown, speckled, except on the abdominal segments, with black.

Distribution—The species has a wide distribution. It ranges from Maine to the mountains of western Pennsylvania, thence southward along the central ridge of the Alleghanies into West Virginia. It is found in Canada, extending westward into the Rocky Mountains.

In the state it has been taken at Missoula, Mount Lolo, and Flathead Lake by Elrod, and at Bozeman by Cooley. It does not seem to be represented in Wiley's collections. According to Coubeaux it is common in the Bear Paw Mountains.

THE EURYNOME FRITILLARY.

Argynnis Eurynome, Edwards. Fig. 54.

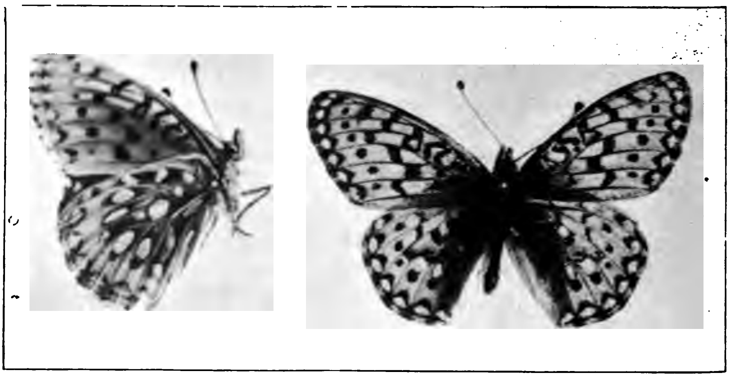


Fig. 54. **Argynnis eurynome.**

Butterfly—Expanse, male, 1.70-2.00 inches, 45-50 mm.; female, 2.00 ches, 50 mm. The wings on the upper side of the male are bright yel- wish fulvous, but little obscured at the base. The outer margins are lged by two fine lines which are occasionally confluent. The under de of the fore wings is pale buff, laved with cinnamon brown at the ise and along the nervules; the spots on the margin and in the apical ea are well silvered. The hind wings on the under side are buff, with e basal and discal areas mottled with pale brown or pale olive-green. ie marginal belt is broad and clear buff; all the spots are well silvered.

The female is like the male, but paler, with the dark markings, espe- ally those of the margin, heavier; the marginal spots inclosed by the nules are much paler than the ground-color, and in many specimens most white. On the under side the wings in this sex are like those of ie male, but the fore wings are more heavily laved with ciannamon- own at the base.

Early Stages—The egg has been figured by Edwards, otherwise we ust say unknown.

Distribution—Common in Colorado, Montana, and British America, iowing much variation. Dyar calls **erinna, bischoffi, artonis, clio, arge** ad **cunninghami** varieties of the species. Eurynome has been taken in ie state by Cooley at Bozeman, 4,800 feet, and 9,500 feet; by Elrod in ie Swan Range at 6,500 feet, Flathead at 3,000 feet, and Mount Lolo; by ouglass in the Tobacco Root Mountains 8,000 feet, Madison valley, Ruby [ountains; by Brandegee on Mount Ascension and near Helena, and by arnes at Aldrich. Coubeaux says it is rather common in the Bear Paw [ountains. Allen has collected it at Dillon.

Var. **Clio**, the Clio Fritillary. The spots on the underside are with- ut silver. Otherwise like the type.

Taken by Cooley in Gallatin County at 6,800 feet elevation, and at hields river at 6,700 feet. A specimen with very little silver was taken y Elrod in the Swan range at 6,700. A female taken by Dr. Coues at hief Mountain August 21, 1874.

Holland says "The female very closely resembles the female of **rtonis**, and in fact I am unable to distinguish the types of the two pecies by any marks which seem to be satisfactory."

Var. **bischoffi**, Bischoff's Fritillary, is like the type, but the upper lde is heavily obscured by black, concealing the basal wing markings. he female has the spots within the lunules pale and almost white. It a boreal form.

Taken by Cooley. Three specimens, one from Shields river, 6,700 et, two from Gallatin county, one at 8,300 and one at 9,400 feet.

Var. **artonis**, the Artonis Fritillary, may be distinguished "by the ntire absence of silvery scales upon the under side of the hind wings, nd also by the fact that the silver spots on the under side of the hind ings are not compressed and elongated as much as eurynome, and by ie further fact that all the dark marginal markings of the under side re obliterated. In the female the dark markings underneath are eavier. It has been found in Colorado, Nevada, Utah and Arizona. We ave one specimen from the Yellowstone Park.

Butterflies at Miles City, Montana.

A barren country surrounds Miles City, the center of the great grazing territory of eastern Montana, a country of prairie and badlands with little verdure other than that on the immediate border of the rivers and in the creek bottoms.

Here a lover of groves and forests must be content with a variety of trees that might easily be enumerated on his ten fingers, and but few of even these.

Cottonwoods, broken and scrawny, are the only trees of large size near the city, but as one penetrates the country to the heads of the Yellowstone's many tributaries, he meets with ash, elm, box-elder and willows, all native varieties, and differing somewhat from the same trees of the eastern states.

In the badlands and in the hilly sections are pines and cedars also, but the majority of our country is a vast prairie, grass clothed, but bare of tree or shrub (the ever-present sage-brush excepted) and parched by the sun from July until winter.

What limited amount of shrubbery does occur is also confined to the water-courses. We have our native choke-cherry, wild rose, plum, willow, snowberry, buffaloberry, greasewood and sagebrush, a meagre list indeed, when compared to the hundreds of shrubs and brushes abounding in most eastern localities. All vegetation without it may be grasses, and wild flowers occur with us, but in the most limited variety. We have no woods, no swamps, no hedges. What wonder then that the entomologist's hopes are saddened as he realizes that a corresponding dearth exists among his favored and busy tribes.

I wonder who can recount the exact number of Papilios he has seen during three years past? It is my good (?) fortune to have seen just fourteen during that period. In the season of 1891 I saw but one, it was one of the **Turnus** group, probably **rutulus** or **daunus**, its rapid flight however, baffled detection. In May of this year while returning from our ranch, on horseback, a distance of about one hundred miles, I saw another of this same group, but was unable to capture it. During this trip, also, I counted nine **zolicoan**, only one of which was not in rapid flight across country; this one, a female, was depositing her eggs on our native wild parsnips, and I caught her easily, and obtained some twenty eggs, which I reared on cultivated parsnips in my garden. The only other Papilio seen this year was one related to **zolicaon**, but had none of the prominent show of yellow so characteristic of that species when on the wing. What it may have been I cannot say.

Finally, two specimens of **zolicaon** taken on the summit of Signal Butte, near this city, on May 30, 1892, complete the number. I cite my experience with the **Papilios** to give a general idea of the scarcity of species occurring here.

A few species of **Colias, Pieris, Euptoieta, Phyciodes, and Lycaena** occur here, however in sufficient abundance not to be called rare. There exists an unusually localized distribution among most species here, which doubtless results from a similar localization of the foodplants, many of which are to be found only near flowing springs or other sources of moisture. The **Satyrids, Pamphila,** and other prairie varieties, however, may be met with in country of almost any character, as also may such species as the **Argynnids, Pyrameis cardui** or **Danias archippus.**

This season has proven an unusually productive one, and fully twice the number of butterflies were on the wing this year than appeared in either 1891 or 1892.

Our climate and soil are so dry that no agriculture is successful without irrigation, and I attribute this season's productiveness in the Lepidoptera of this immediate vicinity to systems of artificial irrigation, which has been successfully operated here only the last two seasons, and no doubt all insect life so dependent upon vegetation, will steadily increase as the amount and variety of plant-life is multiplied year by year by the introduction of agriculture under our irrigation systems along the Tongue and Yellowstone River bottoms.

In the interest of the readers of the Entomologist News I append a list of the species of diurnals that I have taken about Miles City during a three years' residence here:

Papilio zolicaon, rare.
Pieris rapae, common.
Pieris protodice.
Anthrocharis olympia, not rare.
Colias eurytheme, common.
Colias eriphyle, common.
Danias archippus, rare.
Argynnis idalia, one differing a little from eastern species.
Argynnis edwardsii, not common.
Argynnis nevadensis, not common.
Argynnis cypris, rare.
Argynnis sp., one.
Euptoieta claudia, one of the most common (averaging small in size).
Melitaea, three species; not common and local.
Phyciodes tharos, rather common.
Phyciodes carlota, quite common.
Grapta zephyrus, one.
Vannessa antiopa, not common.
Vanessa californica, one.
Vanessa milberti, rare.
Pyrameis cardui, not rare.
Pyrameis ? sp. nov. sp., possibly Hy. Edy. Hybrid **caryae et atlanta.**
Limenitis weidmeyerii, rare and local.
Limenitis disippus, rare and local.
Coenonympha ochracea, rather common.
Satyrus alope-olympus, rare.

Satyrus oetus, rare.

Satyrus charon, rather common.

Chionobas varuna, several specimens taken at ranch in July, 100 miles east of Miles City.

Thecla niphon, rare and local.

Chrysophanus hypophlaeas, not rare.

Chrysophanus rubidus.

Lycaena melissa, common.

Pamphila, two or three species, all rare.

Pyrgus tessellata, common.

Pyrgus sp., not common.

Pholisora catullus, common.

Eudamus tityrus, one.

Eudamus sp. one.

—C. A. Wiley in Entomological News for February, 1899.

Genus BRENTHIS, Hubner.

Butterfly—Small or medium size; in form and color very much like Argynnis.

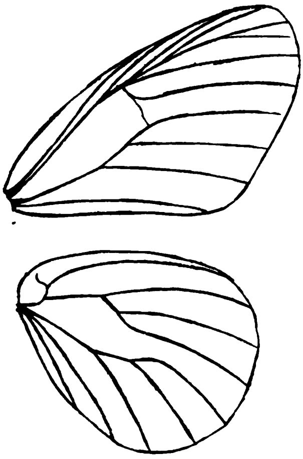


Fig. 55, Venation of Brenthis myrina.

Egg—The eggs are subconical, almost twice as high as wide, truncated at the top, and marked with thirteen or fourteen raised longitudinal ridges connected by a multitude of small cross ridges.

Larva—Smaller and not as dark in color as the larva of **Argynnis**. They feed upon violets.

Chrysalis—It is pendant, about six-tenths of an inch long, and having two rows of sharp conical tubercles on the back.

GENUS BRENTHIS.

Key to Species.

1. Basal part of wings not differing from the rest, 2.
   Basal part of wings black, 3.
2. Under side of wings with silver spots; ocellus at base of hind wings myrina
3. Under side of wings without silver spots and ocellus; a purplish ferrugenous color at the apex, bellona.
   Cinnamon brown at the apex of fore wings; hind wing crossed by a yellow band formed of star-like spots; black ocellus at base of wings, helena.

THE SILVER BORDERED FRITILLARY.

Brenthis myrina, Cramer. Figs. 55, 56.

Butterfly—The upper side of the wings is fulvous; the black markings are light; the borders heavy. The fore wings on the under side are yellowish fulvous, ferruginous at the tip, with the marginal spots lightly silvered. The hind wings are ferruginous, mottled with buff. The spots are small and well silvered. Expanse male, 1.40 inches; female, 1.70 inches, 43 mm.

Egg—The egg is conoidal, about one-third higher than wide, marked by seventeen vertical ribs, between which are a number of delicate cross ribs. It is pale greenish yellow in color.

Caterpillar—In its final stage it is about seven-eighths of an inch long, dark olive brown, marked with green; the segments being adorned with fleshy tubercles armed with needle-shaped projections.

Chrysalis—It is brownish yellow, spotted with dark brown spots, those of the thoracic and first and second abdominal segments having the luster of mother of pearl.

Distribution—It has a wide range, extending from New England to

Montana, from Nova Scotia to Alaska, and southward along the ridges of the Alleghanies into Virginia and the mountains of North Carolina. It has been taken rather abundantly at Crow Creek, Flathead Indian Reservation; at Missoula; at Rimini, 5,500 feet, near Helena, by Brandegee. Taken by Barnes at Aldridge.

One day in July, while camped at Crow Creek along the main wagon road between Selish and Polson Brenthis myrina was found abundantly in the grassy creek bottoms. Almost invariably they were taken on the large blue **Erigeron macranthus**, common in the western part of the state. The afternoon was warm, and was spent almost entirely in butterfly collecting. Nearly all the specimens taken were of this species.

Figs. 55 and 56. **Brenthis myrina**, upper and lower surfaces

August 8, 1904, an afternoon was spent at the upper end of Swan Lake after insects. **Brenthis myrina** was the only common species, resting occasionally on the blue Erigeron or white Achillea. Several dozen were secured, the return to camp revealing two deer in the marsh.

One morning during the last week in August, 1903, as I was wading through the tall wet grass, at the upper end of Swan Lake, just after sunrise, a butterfly was rather abundant above the tops of the grass. The dew was wet and heavy, and no net was at hand. Batting down an insect with my old hat it proved to be of this species. It may be called common west of the range.

THE MEADOW FRITILLARY.

Brenthis bellona, Fabricius. Fig. 57.

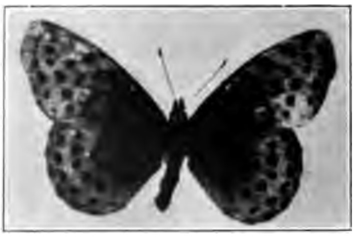


Fig. 57. **Brenthis bellona.**

Butterfly—Pale fulvous on the upper side, with the dark markings on the inner half of the wing narrow, but more or less confluent. The dark markings on the outer margin are slighter. On the under side the fore wings are pale fulvous, spotted with purple at the tip and outer margin. The hind wings below are ferruginous, mottled with purple. Expanse, 1.65-1.80 inches, 41-46 mm.

Early Stages—Similar to that of **B. myrina**, but the caterpillar in its mature form differs in not having the spines on the second segment of the body lengthened as in that species. Chrysalis, bluish gray in color, marked with dark spots.

Distribution—The butterfly is very common in the whole of the northern United States, as far south as Virginia. It occurs throughout Quebec, Ontario, and British America, as far west as the foothills of the Rocky Mountains. In the state taken by Elrod at Missoula and at Swan Lake; by Brandegee at Rimini, near Helena.

THE HELENA FRITILLARY.

Brenthis helena, Edwards, Fig. 58.

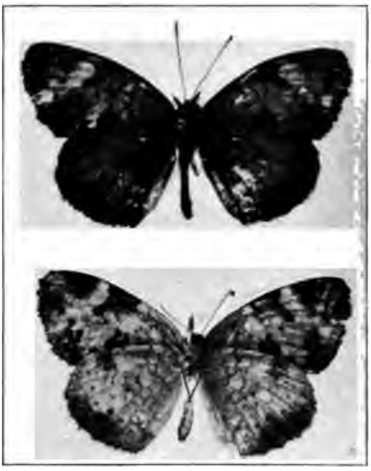


Fig. 58. **Brenthis helena.**

Butterfly—The wings on the upper side are fulvous, greatly obscured by brown at the base of the fore wings and along the inner margin of the hind wings. The usual markings are light, and the marginal border is also not so heavily marked as in **B. myrina.** The fore wings on the under side are pale fulvous laved with ferruginous at the tip. The hind wing' brightly ferruginous, with small yellow marginal spots and paler spots inclining to buff on the costal border and at the end of the cell, about the region of the median nervules.

The female is very much like the male on the upper side, but the ground color is paler. On the under side the markings are more conspicuous. Expanse, 1.40 inches, 35 mm.

Early Stages—Unknown.

Distribution—**Helena** appears to be a common species in Colorado, Montana and New Mexico. It is subject to considerable variation, both in the intensity of the coloring of the under side of the wings and in the distinctness of the maculation.

The collection contains two from Missoula and three from Flathead Lake. Cooley has specimens from near Bozeman June 27, 1900, at 6,800 feet, and July 12, 1900, at 8,000 feet.

THE CHECKER-SPOTS.

Genus Lemonias, Fabricius.

This group includes some of the smaller members of the Nyphalinae. The color of the wings is sometimes black, with red and yellow spots; but it is usually fulvous, with the fore wings broadly margined, especially at the apex, with black, and crossed by many irregular lines of black. About fifty species occur in this country.

Key to Species.

1. General color black, with a terminal border of red spots; spotted with red and yellow 2.
   General color red or fulvous, very little black 3.
   General color brownish black 4.
2. Under side brick red with the yellow repeated, size 1.75 to 2.50 inches, 45-64 mm. chalcedon.
   Under side brick red, the yellow wanting cooperi.
   Under side with small spots. brucei
   Smaller, about 1.50 inches, 38 mm., more red and yellow anicia.
   Black above, a row of small, marginal, brick-red spots, size small taylori.
3. Under side of fore wings fulvous, with a little yellow at the apex; hind wings with a great deal of yellow whitneyi.
   Basal area black hoffmanni.
   Under side red, often one row of yellow spots nubigena.
   Under side of hind wings heavily and regularly banded with yellowish white spots, possessing pearly luster acastus.
4. Both wings with marginal rows of red spots leanira.

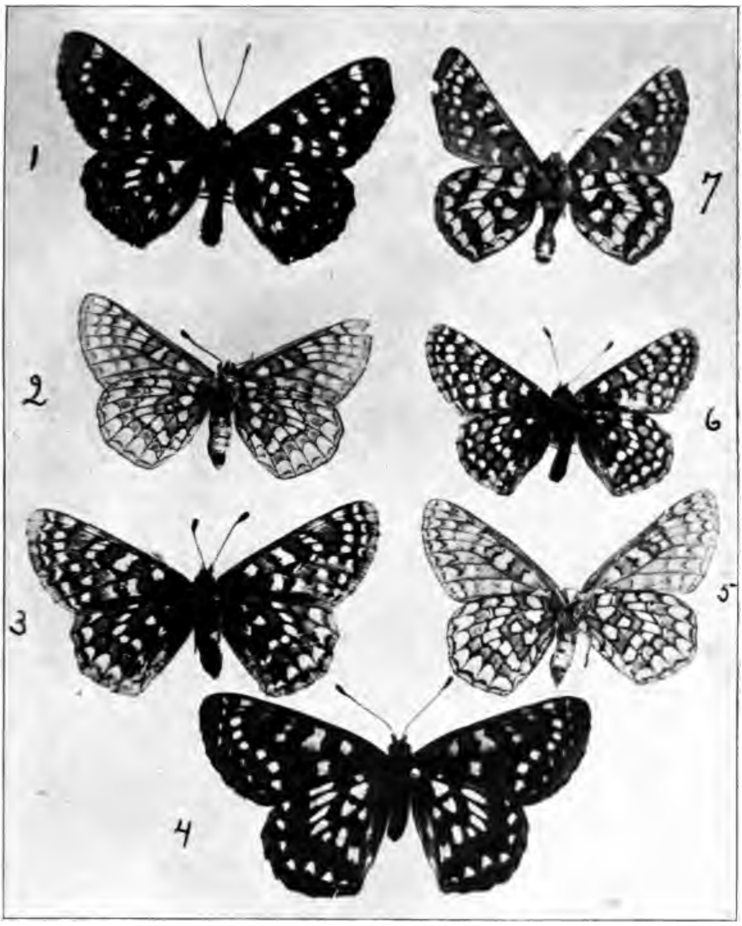
THE CHALCEDON CHECKER-SPOT.

Lemonias chalcedon, Doubleday and Hewitson. Plate IV, Plate I.

Butterfly—Male and female are much alike. The wings are black, spotted with red and ochreous yellow. On the under side they are brick-red with the spots of the upper side repeated, and in addition at the base a number of large and distinct yellow spots. Expanse, male, 1.75-2.00 inches, 45-51 mm.; female, 2.50 inches, 64 mm.

Early Stages—The egg is pale yellowish when first laid, pitted at the base, and ribbed vertically above. The caterpillar is black, with the bristles projecting on the segments quite long. The chrysalis is pale gray, blotched with brown. The food plants are Mimulus and Castilleia.

Distribution—It is common in northern California. In Montana is has been taken abundantly at Missoula. One was captured at Geyser Basin, National Park.



Lemonias chalcedon, upper surface 1 and 4; lower surface, 7; Lemonias anicia, upper surface, 3 and 6; lower surface, 2 and 5.

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THE ANICIA CHECKER-SPOT.

Lemonias anicia, Doubleday and Hewitson. Plate IV.

tterfly—Smaller than **chalcedon**, with a great deal of red on the .nd discal areas of both wings upon the upper side. Expanse 1.50 38 mm.

rly Stages—These are unknown.

ıtribution—**L. anicia** is found in Colorado, Montana, Washington, ·itish America. The University of Montana collection embraces ens from Geyser Basin (13), Missoula (3), Aldridge (1). Coubeaux tolerably common in the mountains near Big Sandy.

TAYLOR'S CHECKER-SPOT.

Lemonias taylori, Edwards. Fig. 58.

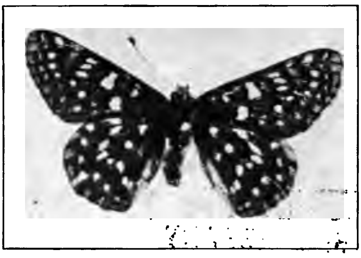


Fig. 58. **Lemonias taylori.**

ıtterfly—Expanse of male, 1.25 to 1.50 inches, 32-38 mm.; female, 1.75 inches, 38-45 mm. Ground color black above; a row of small ıal brick-red spots, largest at the apex; two rows of small light or almost quite white spots across fore and hind wings, the outer ı fore wings sometimes reduced to mere specks; on the hind wing is usually a row of brick-red spots between the rows of yellow within these rows there are about three or four basal yellow spots ger than the largest spots in the rows; the cell of the fore wings small basal yellow spot, then a larger red bar sometimes broken, ɘd by three yellow dashes making a bar, a large yellow spot, about iddle of the wing below the cell; costa of fore wings brick red, st at the base; the under side is brick-red, the spots above re- and much larger; on the fore wings the yellow spots are washed y red, and almost lacking on hinder part of wing; legs, palpi, sides omen brick-red; under side of abdomen same color as yellow spots.

ırly Stages—The food is said to be the ribwort plantain (Plantago lata Linn.)

istribution—It is reported from Vancouver's Island. Prof. Cooley ıe specimen from Cascade, on the Missouri river, one from Gallatin y, and one from Missoula; Barnes has several from Aldridge.

BRUCE'S CHECKER-SPOT, Lemonias brucei, Edwards.

utterfly—Male: Expands from 1.5 to 1.7 inch 38 to 40 mm. Upper ɔrown-black, marked with spots of red and yellow in transverse ; there are three well-marked varieties, in one of which red predominates, sometimes almost to the exclusion of yellow; in another red and yellow, much as in other allied species; on the third much yellow, very little red; so that the black surface is more exposed than in many species.

1. The red form. The spots dull; the common marginal row wholly red, the submarginal row sometimes red on primaries, sometimes red partly replaced by yellow, and secondaries always red and yellow; the the third row is red and yellow on primaries, red on secondaries, the fourth row just the reverse of this; at end of cell on primaries a short red and yellow band, in the cell four spots, red and yellow alternately, from the arc, the yellow ones very small; on secondaries, a red stripe along upper side of cell, two small yellow spots in cell; fringes black at ends of the nervules, yellow in the interspaces.

2. The spots of the second row red and yellow on primaries, yellow on secondaries; the two next costa sometimes red on the posterior side; the yellow spots in cell of primaries large, and a large yellow patch below cell.

3. Nearly all spots yellow; the marginal red; no other red on secondaries, or a mere trace of it indicating the spots of the third row, which are otherwise suppressed; the submarginal row of primaries represented by a few scales only, as are also the spots in cell.

On the under side all three forms agree; primaries dull red, almost without black; the marginal spots a deeper red, the next two rows yellow, the submarginal obsolete on lower half; a yellow patch subapical on costa, another outside arc of cell ;the two cellular spots yellow, dusted red.

Secondaries have all the spots clearly defined; the marginal row red, the second row of yellow lunules; the third wholly red; the fourth yellow, the spots of upper half elongated and cut unequally by a black line from costa to lower discoidal nervule; beyond to base red, with a straight row of four confluent spots from costa to sumedian, and a fifth at end of cell.

Female—Expands 1.7 to 1.8 inch, 40 to 42 mm. Varies as the male, but some examples still more widely, the yellow spots being very large. On the under side as in the male, except that some examples have the red submarginal spots of secondaries slightly edged with yellow; in the more yellow upper side examples the yellow edging to these spots is broader, and even sometimes extends along the marginal side.

This small Melitaea has long been known in collections, but till recently I myself have seen few of them, and knew nothing of its localities or habits. Mr. Bruce, who took great numbers of examples, says: "I found it only on high mountain tops (in Colorado); this was strictly the rule. These tops are in most cases extensive plains covered with flowers, chiefly yellow compositae, and the Melitaeas in question sit on every blossom in numbers, and are very sluggish—or rather I may say, they sit and cling tightly to the flowers to prevent the brisk wind, that is generally blowing at this elevation, from taking them away. I have never seen them down the slope lower than a few hundred yards. It is an abundant species on the Snowy Range at not lower than 12,000 feet, and must appear early in June, as many of my specimens taken early in July are rather worse for wear."

The species comes also from Montana, Washington Ter., and British America, in the Rocky Mountains. (The above is the original description in Can. Ent.)

THE ACASTUS CHECKER-SPOT.

Lemonias acastus, Edwards.

Butterfly—Expanse, 1.50 to 1.60 inches, 38-41 mm. Prevalently fulvous upon the upper side, and on the under side of the hind wings heavily and somewhat regularly banded with yellowish-white spots, possessing some pearly lustre.

Early Stages—Unknown

Distribution—Nevada, Utah, Montana. We have not taken it.

HOFFMANN'S CHECKER-SPOT.

Lemonias hoffmanni, Behr.

Butterfly—Expanse, 1.35 to 1.45 inches, 35 to 37 mm. General style of marking similar to **L. whitneyi**, but with the basal area black, and the black markings toward the outer margin not so heavy, giving it here a more fulvous appearance. Under side much as in **whitneyi**, but the yellow markings are more prominent. Subject to much variation.

Early Stages—Unknown.

Distribution—Found in California, Oregon, Nevada, Colorado, Montana. We have not taken it.

THE LEANIRA CHECKER-SPOT.

Lemonias learnira, Boisduval.

Butterfly—Expanse, 1.50 to 1.75 inches, 38 to 45 mm. Ground color brownish-black, fulvous on the costa, with submerged median, and basal rows of yellow spots. Both the primaries and secondaries have a marginal row of red spots, and the former have in addition a sub-marginal row of such spots. The under side of the primaries is reddish fulvous, with the markings of the upper side reproduced. The secondaries have a marginal row of crescents, then a black band inclosing yellow spots, then a median band of long yellow crescents. The remainder of the wing to its insertion is black, spotted with yellow.

Early Stages—Unknown.

Distribution—Colifornia, Arizona, Nevada, Montana, British America. We have not taken it, nor is it in any of the collections.

THE CLOUDED CHECKER-SPOT.

Lemonias nubigena Behr. Fig. 60.

Butterfly—Expanse, 1.20-1.50 inches, 30-38 mm. Small, characterized by the red ground color of the upper side of the wings. The species is susceptible of great variations. The markings are quite similar to those of other species, but the size is small. In the variety Wheeleri the black ground-color is greatly reduced and almost wholly obliterated on parts of the primaries.

Distribution—Found in Nevada. Collected by Cooley at Bozeman.

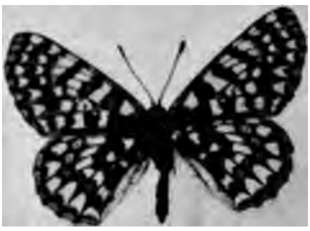


Fig. 60. **Lemonias nubigena, from Colorado.**

WHITNEY'S CHECKER-SPOT.

Lemonias whitneyi, Behr. Figs. 61 and 62.

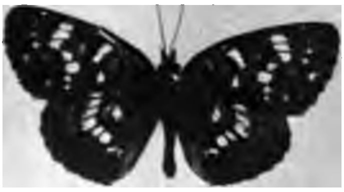


Fig. 61. **Lemonias whitneyi.**

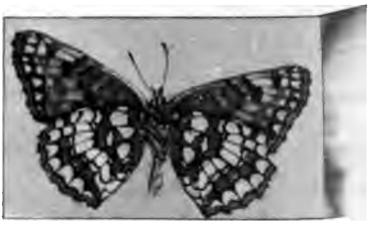


Fig. 62. **Lemonias whitneyi, under side.**

Butterfly—Fulvous upon the upper side. Prominent yellow bands on under side of hind wings. The yellow is more prominent in the male than in the female. Expanse male, 1.50 inches, 38 mm.; female 1.70 inches, 44 mm.

Early Stages—Altogether unknown.

Distribution—It ranges from California into Nevada, north to Montana.

Taken at Sinyaleamin lake in the Mission Mountains by Elrod; near Helena by Brandegee; in Bridger canyon and Gallatin county, elevation 7,500 feet by Cooley; Miles City by Wiley.

COOPER'S CHECKER-SPOT, Lemonias cooperi Behr.

Butterfly and Early Stages—This species is very similar to **chalcedon**, but the want of the yellowish halo around the lunulae of the brown band on the under side, is a very positive diagnostic character. The brown color of the bands also is always of the same somber hue as that of the under side of the fore wings, and never of the fiery brick red that colors this fascia on the under side of **chalcedon**, forming a perceptible contrast to the somber coloring of the under side of the fore wings, which is the same in **chalcedon** and **cooperi**. With all these well marked differences, the two species look so much alike, that it would have been a long time before **cooperi** would have been recognized as a distinct species, if it had not been for the striking difference of its caterpillar, which was discovered by Mr. Lorquin near Clear Lake on a species of **Scrophularia**. This caterpillar is much more elongated than that of **chalcedon**. It is nearly of the shape and coloration of the European **artemis**, brimstone yellow, with a dorsal and a lăteral black stripe. We were quite justified in expecting from such a caterpillar something strikingly different from the very common type of **chalcedon**. But to our surprise our chrysalids gave us a series of crippled butterflies, which could scarcely be distinguished rom **chalcedon**. Since that time I have received a well developed specimen through the kindness of Baron Koels, who caught it with several other insects on an excursion to Mount Tamal Pais.

It is pretty certain that **cooperi** will be found in many other localities, as it is only its similarity to our most common vernal butterfly, the **chalcedon**, that makes it escape our attention."

(The above was kindly copied by M. E. Hyde, Asst. Sec. Calif. Acad. Sci., from Behr's original description as given in the Proceedings for 1863-68, Vol. 3, p. 90.)

Distribution—Found in Washington, Vancouver's Island, and the Big Horn Mountains, Montana.

THE CRESCENT SPOTS.

Genus PHYCIODES, Doubleday. Fig. 63.

Butterfly—Generally quite small. Their wings on the upper side are fulvous, or brown, with black margins, spots and lines, and with the under side of the wings reproducing the spots of the upper side. Of the spots of the under side of the wings one of the most characteristic is the pale crescent situated on the outer margin of the hind wings. In the neuration of the wings these butterflies are much like Lemonias.

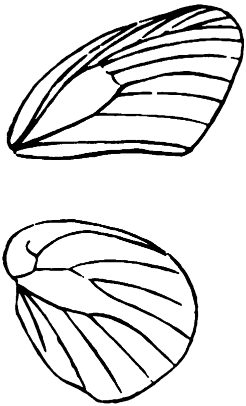


Fig. 63. Venation of Phyciodes.

Eggs—The eggs are always higher than broad, having a thimble-like appearance.

Caterpillar—The caterpillar is cylindrical, marked with longitudinal stripes, and adorned with tubercles. They do not so far as known weave webs.

Chrysalis—It is pendant, with the head slightly bifid. The color is generally some shade of pale gray, spotted with black or brown.

They are found in South and Central America, the United States and Canada.

GENUS PHYCIODES.

Key to Species.

1.	Broad central band of white or light buff on under side	2.
	Central band of under side narrow or wanting, sub-marginal row of spots small	3.
2.	Sub-marginal row of spots on under side with no more than one pupiled with white	carlota.
3.	Upper side of fore wings with fulvous bands	4.
	Upper side of fore wings with whitish bands	5.
4.	Fulvous band broad, narrow black border	tharos
	Fulvous band narrow, deep border	pratensis
5.	Spots on hind wings above pupiled with black	camillus
	Hind wings with broad median and narrow sub-marginal whitish bars	mylitta

THE PEARL CRESCENT.

Phyciodes tharos, Drury. Fig. 64.

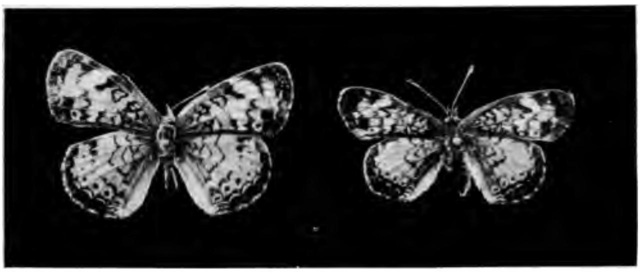


Fig. 64. **Phyciodes tharos,** slightly reduced.

Butterfly—Expanse, male, 1.25 inches, 32 mm.; female, 1.65 inches, m. Upper surface reddish fulvous marked with black; two rows ore or less coalescing circles near the base of the wing, the first vo circles, the second of four, and an ellipsoid at the end of the cell; tch of black beyond the cell on the costa and one on the hind margin, etimes the two being connected by a dentate line. The outer border road, black, and through it runs a crenated line with a yellowish or ous lunule in the middle, in some examples distinct, in others coned with the central color; black dot near the posterior angle.

Hind wings similar to front wings, the median black band narrower; light bands are fulvous, and the outer contains a row of black spots.

The under side of fore wings yellowish fulvous, with yellow spots four black patches, two on the costa before the apex, one at the erior angle, and one on the hind margin.

The under side of hind wings pale buff washed with umber-brown, basal half with more or less complete bands of pale spots edged with vn; the row of black spots same as above; a sub-marginal row of les, the middle large, silvery, the others more or less obscure. The inal, costal, and middle brown patches are present in some examples, wing being well suffused with brown.

Early Stages—The egg is light greenish yellow. The caterpillar, h feeds upon various species of aster and allied compositae, is dark vn after the third moult, its back dotted with yellowish and adorned short black bristly spines, which are yellow at the base. The salis is grayish white, mottled with dark spots and lines.

Distribution—This is one of the many dimorphic species. It ranges southern Labrador to Florida, in fact all over North America, north of as and south of the region of Hudson Bay, except the Pacific coast of fornia. Found in Montana at Missoula, Fish Creek, Ruby Mountain, v Creek. Brandegee has it in his collection from Gold Creek. Wiley ected it at Miles City. It is abundant around the Biological laboratory Bigfork. It is abundant in the Bear Paw Mountains, according to beaux. Dr. Elliott Coues collected it at Milk River July 25, 1874, called Edwards **Marcia,** now recognized as a synonym for **tharos.**

THE CARLOTA CRESCENT.

Phyciodes carlota Reakirt. Fig. 65.

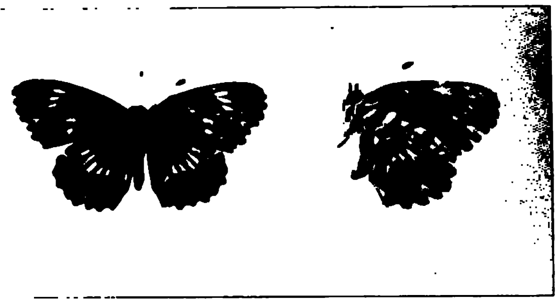


Fig. 65. **Phyciodes carlota.**

Butterfly—Upper surface black; some fulvous spots near the base of the fore wings; a fulvous band through the middle crossed by the black veins; a sub-terminal row of whitish dots in the broad black terminal border; and a white lunule in the middle of the border near the edge of the wing. In the females there are traces of other white lunules just within the margin. The hind wings similarly marked, except that there is a row of black sub-marginal spots circled with fulvous, and the lunules are faint in the males.

Under side of fore wings fulvous, with three or four not very prominent bars in the cell. a somewhat triangular patch beyond, and a terminal brown black border with the sub-terminal row of spots, between median venules one and two there is a large conical whitish spot, the base on the double terminal line; this double line running in zigzag to the apex, and the inner points silvered more broadly towards the apex, and the inner point sending a white ray to the margin. The same is repeated towards the posterior angle, but with less silver.

The hind wings dark brown washed with whitish, more towards the base, only two yellowish spots in the cell. Near the base is a broken silvery band, and through the middle a silver band crossed by the brown veins, the outer margin dentate. The sub-marginal row of black spots pupilled with white. The margin is similar to that of the fore wings, save that the large spot is silvery instead of whitish.

Distribution—It is found in the southern and western states, Rocky mountains, Montana to Arizona. Wiley has many specimens in his collection from Miles City and Sandstone. He bred specimens in 1890. It is not reported by the other collectors.

THE MYLITTA CRESCENT, Phyciodes Mylitta, Edwards.

Butterfly—Expanse of male, 1.15 inches, female larger. Broadly bright fulvous on the upper side, the dark markings slight; a narrow band of dark on outer edge of both pairs of wings, then a sub-marginal row of crescents, bordered with black; hind wings with a row of small black spots, a black spot on anterior edge and dark base; fore wings crossed by two series of black markings like bands, in addition to the preceding; bases dark. Under side fulvous, fore wings with some black at posterior angle; behind this or hind wing, a large light patch; a light patch bordered with dark at middle of outer edge; many light spots on hind wing, making at least two rows.

Early Stages—The food plant is the thistle. The caterpillar is black, yellowish below, with a faint twinned yellow dorsal line and faint lines of the same color on the sides. The spines, which are arranged in six rows, are black. Those of segments four, five, and six, yellow. The chrysalis is dull wood-brown.

Distribution—Washington to Arizona, eastward to Colorado. In the state taken at Helena, July ,2 '03 (1), at Flathead lake, July, '04 (1), and in Yellowstone Park (1). Allen has collected it at Dillon.

THE MEADOW CRESCENT SPOT.

Phyciodes pratensis Behr. Fig. 66.

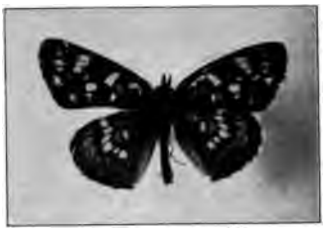


Fig. 66. **Phyciodes pratensis.**

Butterfly—Expanse, male, 1.15 inches, 30 mm.; female, 1.40 inches, 36 mm. Ground color black or dark brown; in the discal cell of the fore wing a prominent light bar; between this and base of wing several smaller light spots; beyond the bar and between it and the light band a small somewhat triangular fulvous bar; two rows of light fulvous or yellowish spots crossing the wing, the inner lighter and with larger spots, the anterior blending to make a broad bar crossed by the dark nerve lines; a sub-marginal row of lunules, the middle one much larger; border black, with a fringe of light hairs alternating with dark, making small light crescents.

Hind wings similar to the fore wings; the inner band is well marked, broad, crossed by the dark veins of the wing; outer band containing black spots, giving the appearance of fulvous spots pupilled with black, anal edge of the wing black, washed with fulvous; sub-marginal row of light yellow lunules, the third from the anal angle largest; these lunules sometimes almost lacking; border as in front wings.

Under side of fore wings yellowish fulvous with yellow spots and black patches; a rectangular black spot on the middle of the hinder edge; this joins a series of small black lunules and black patches, making a bar across the wing, behind which is a wider yellow bar made in the same manner; in some specimens these are reduced; almost disappearing; but there is always a dark irregular line across the center of the wing; a sub-terminal double black lunule touching the hinder margin behind the large black spot; a small costal black dot; apex and base prevailing color of the light bands; a fine brown line a short distance from the outer edge, semicircular between the veins resembling a border of lunules.

Under side of hind wings pale buff washed with umber-brown, the light spots above appearing, usually much lighter than above, even silvery white, many fine brown lines crossing the wings or enclosing light spots; the row of black spots same as above; a sub-marginal row of lunules, the middle one large, silvery, the others more or less obscure, in good examples edged with brown within and without; border as in front wings.

Antennae black, ringed with white at the joints, knobs same color as upper surface; body above dark brown or black, legs color of under surface of wings, under side of abdomen light.

The female has the black markings of the upper side heavier than the male, and all the spots pale yellow. The markings on the under side are heavier than in the male sex. In the male the under side is pale fulvous, spotted with yellow.

Early Stages—Unknown..

Distribution—The range is along the Pacific coast from Oregon to Arizona. Dyar reports it from the Kootenai district of British Columbia. Brandegee has two from near Helena, July 6, 1902; one July 2, 1903. Elrod has one from Flathead lake, July 1904. Several specimens from the Bear Paw Mountains I take to belong to this species.

THE CAMILLUS CRESCENT.
Phyciodes camillus, Edwards, Fig. 67.

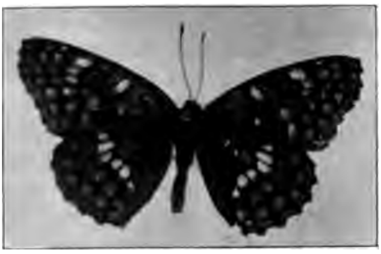


Fig. 67. **Phyciodes camillus.**

Butterfly—The light spots on the male are paler on the primaries, on the secondaries brighter fulvous. The dark markings on the under side are less pronounced. The female is much like the male. Expanse, male, 1.30 inches, 33 mm.; female, 1.50 inches, 38 mm.

Early Stages—Wholly unknown.

Distribution—The species is reported from British Columbia, Montana, Kansas and Texas. In Montana taken at Sinyaleamin Lake, Mission Mountains, Missoula, and at Helena (Brandegee). Cooley has collected it at Bozeman. Collected by Coubeaux at Big Sandy.

A Chrysalis.

My little Maedchen found one day
A curious something in her play,
That was not fruit, nor flower, nor seed;
It was not anything that grew,
Or crept, or climbed, or swam, or flew;
Had neither legs nor wings, indeed;
And yet she was not sure, she said,
Whether it was alive or dead.

She brought it in her tiny hand
To see if I would understand,
And wondered when I made reply,
"You've found a baby butterfly."
"A butterfly is not like this,"
With doubtful look she answered me.
So then I told her what would be
Some day within the chrysalis:

How, slowly, in the dull brown thing
Now still as death, a spotted wing,
And then another, would unfold,
Till from the empty shell would fly
A pretty creature, by and by,
All radiant in blue and gold.

"And will it, truly?" questioned she—
Her laughing lips and eager eyes
All in a sparkle of surprise—
"And shall your little Maedchen see?"
"She shall!" I said. How could I tell
That ere the worm within its shell
Its gauzy, splendid wings had spread,
My little Maedchen would be dead?

Today the butterfly has flown—
She was not here to see it fly,—
And sorrowing I wonder why
The empty shell is mine alone.
Perhaps the secret lies in this:
I too had found a chrysalis,
And death that robbed me of delight
Was but the radiant creature's flight!

—MARY EMILY BRADLEY.

GENUS POLYGONIA, HUBNER.

The Angle-Wings. Fig. 67.

Butterfly—Medium sized or small, characterized by the more or less deeply excavated inner and outer margins of the fore wings, the tail-like projection of the hind wings at the extremity of the third median nervule, the closed cell of the fore wings, and the thick covering of scales on the upper side of the palpi, while on the sides and tops of the palpi there are but few scales. They are tawny on the upper side, spotted and bordered with black; on the under side mimicking the bark of trees and dead leaves, often with a C-shaped silvery spot on the hind wings. The insects hibernate in the butterfly form in hollow trees, under bark and leaves, and like places.

Early Stages—The eggs taller than broad, tapering upward from the base. The sides are ribbed. They are laid in clusters or in a short string-like series. The caterpillar is cylindrical, adorned with rows of branching spines. They feed upon the nettle, elm, hopvine, and other plants

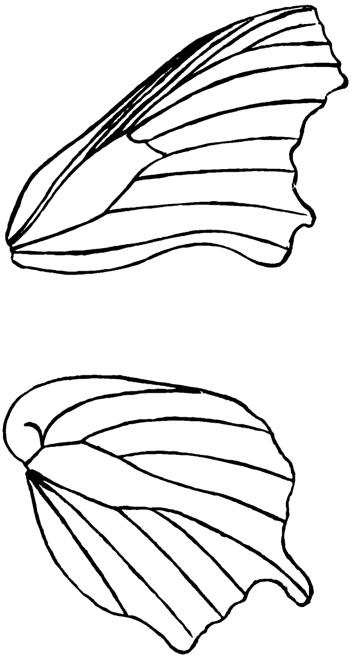


Fig. 67. **Venation of Polygonia.**

Key to Species.

Small, under side crossed by a pale gray or white band	gracilis.
Under side marked with dark and pale shades, heavy black border above	faunus.

Under side paler, yellowish brown	zephyrus.
More decided markings than the last	satyrus.
Under side pale purplish gray	hylas.
Under side very dark, paler irrorations	silenus.

THE FAUN.

Polygonia faunus Edwards. Fig. 68.

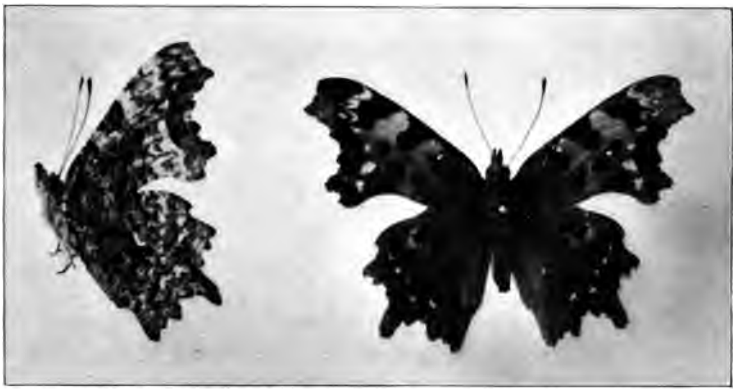


Fig. 68. Polygonia faunus.

Butterfly—Upper surface fulvous, dark, the hind wings darker. Next the apex of the fore wings, the base of both wings, and the inner margin of hind wings dusky. Border of wings broad and dark brown or black, in the fore wings dentate at the apex, and bordered within by a series of sub-obsolete tawny lunules. There are two spots and a bar in the cell, and a bar at the end, but there are only three round spots between the cell and the posterior angle, the lowest supplemented by a shade above it. The spots are very dark or black.

Hind wings with dark ferruginous next the border, shading toward the middle, a series of paler spots next the border and an irregular roof of black spots across the middle.

Under side of both wings dark brown on the base, with an irregular common blackish band across the middle, darkest on its outer edge and within the abdominal margin, where its outline is obliquely serrated. Beyond this band the color is pale brown mottled with grayish white, which is clearest on the fore wings. The whole surface is clouded with vinous, and more or less crossed by fine abbreviated streaks of brown. Apex of fore wings yellow-brown, with three small lanceolate ferruginous spots, the lower enclosing a blue or green point. The outer margin of both wings, below these, is bordered by a series of confluent blue-black, sometimes olive-green spots following the outline of the wing. Within these is another series of rounded spots of the same color. On the disk of the hind wings is a white G varying in form.

Early Stages—The mature larva is one and a quarter inches long;

head black, with two branching horns and a few scattered white hairs. Upper side of joints 2 to 6 brick-red, stripped transversely with blue, yellow and black, a few white hairs on joint 2. There are four branching yellow spines, with black tips, on joints 3 and 4, and six on joints 5 and 6. Joints 7 to 12 are white, with a faintly marked black stripe along the back, each joint with three transverse yellow bands and two oblique black spots. These joints have each seven spines, all white except the one next the lowest, which is brown. Last two joints black, with seven and four spines respectively. Sides red, with two black bands, the lowest spotted with blue.

The chrysalis is grayish brown Head with two bi-forked horns, the outer point very short: thorax with an elevated keel-like ridge on top, with a small tubercle on each side

The food plants are gooseberry, currant, willow and birch.

Distribution—It is found from New England south to the Carolinas and west to the Pacific.

The collection at the University embraces specimens from Missoula, Sinyaleamin Lake, Flathead Lake, Swan Lake (many).

At Swan lake, August 20, 1903, **faunus** was abnudant at Bond's cabin, but was very hard to take. It was flying about the lake shore and around the cabins of Bond and Groom, forest rangers, in common with **Vanessa J. album, Vanessa californica Polygonia satyrus** and **P. zephryus.** Although quite abundant comparatively few were taken. Brandegee has taken it at Helena.

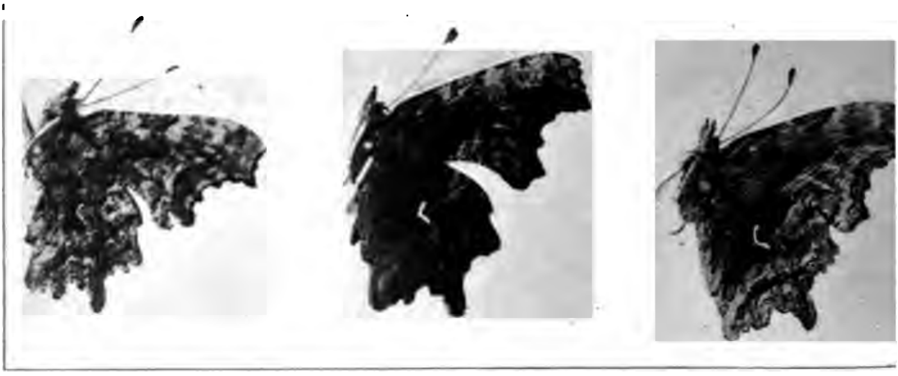


Fig. 69. **Polygonia faunus** on the left, black **satyrus** in the middle, **zephyrus** on the right, under side of wings.

THE SATYR.

Polygonia satyrus, Edwards. Fig. 69.

Butterfly—Expanse 1.75 to 2.00 inches, 45-51 mm. Tawny or fulvous above. Wings with dark brown, almost black border. A row of lunules of lighter color than ground work within the black border. General color much lighter than **faunus.** Inside of the lunules is a wash of reddish brown, almost making a line across both wings, more conspicuous on hind wings. Bases of wings brownish black Under side of wings dark, with light mottlings and marblings. Apex of fore wings lighter. The light markings make a band across the wings, the inner margin of which crosses the middle of the wings. A light patch usually on costa of fore wings, between light band and base. Wings deeply excised. Legs and feet light colored. Antennae ribbed below, with black clubs, the ends of which are of the same color as the upper surface of wings.

There are two forms. One is very dark below, almost black, with a white open C like in **faunus.** The other is much lighter below, the color being a dark brown, the spot on hind wings forming a G, larger. The under surface is broken by darker brown patches extending crosswise of the wings. Above the wings are lighter and the black spots much smaller.

Early Stages—The caterpillar feeds on the nettle.

Distribution—From Ontario to the Western part of the United States. It has been collected in the state by Elrod at Missoula, at Sinyaleamin and Swan lakes; by Cooley at Bozeman, September, 1899; by Brandegee at Helena.

THE ZEPHYR

Polygonia zephyrus, Edwards. Fig. 70.

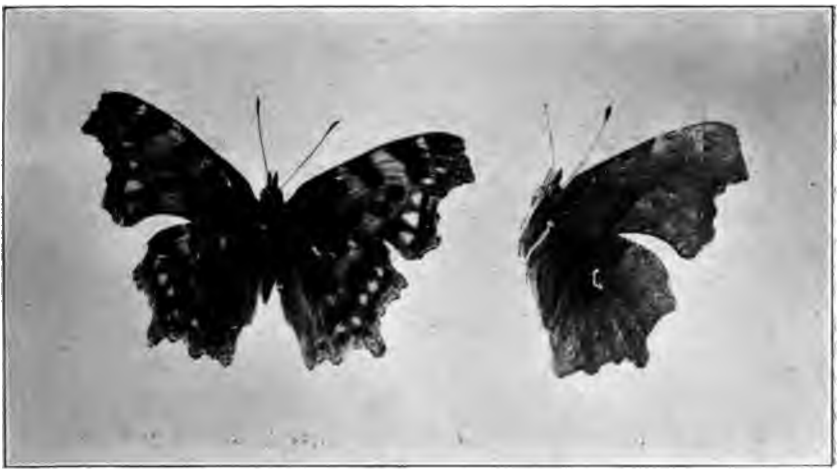


Fig. 70. **Polygonia zephyrus.**

Butterfly—Upper side of wings similar to **faunus** and **satyrus,** fulvous, marked with yellowish toward the outer margins, the dark markings upon which are not as heavy as in the other species. Below the wings are much paler than in **faunus** or **satyrus,** reddish brown,, marbled with darker brown lines; the band across the wings is quite light, the female with a row of small light yellowish spots pupiled with black.

Distribution—Rocky Mountain region from Colorado to California, and from Oregon to New Mexico (Holland). Taken in Montana by Cooley at Bozeman, by Wiley at Miles City, Brandegee at Helena, and by Elrod at Missoula. One worn specimen from Bear Paw Mountains belongs to this species.

THE GRACEFUL ANGLE-WING.

Polygonia gracilis, Grote and Robinson.

Butterfly—A small species, rather heavily marked with dark or blackish on the upper side. The wings on the under side are very dark, crossed about the middle by a pale gray or white band, shading off toward the outer margins. This light band serves as a means of easily identifying the species. Expanse, 1.75 inches, 45 mm.

Early Stages—Unknown.

Distribution—The species has been found on White Mountains in New Hampshire, in Maine, Canada and British America, as far west as Alaska.

While the species is recorded as having a western distribution it has not been taken by the writers in the state, nor is it reported in the other collections.

THE SILENUS ANGLE-WING.

Polygonia oreas, var. silenus, Edwards.

Butterfly—Expanse, 2.2 inches, 56 mm. Primaries moderately incised; slightly dentated; tail long, broad and straight; a prominent dentation between tail and inner angle, which last is much pronounced. Upper side deep red-fulvous, clouded with brown-ferruginous next base of each wing and on disks, and spotted with black, hind margins have a broad cinnamon border of nearly uniform width, black with a ferruginous tint; on the inner side a series of separate, pale fulvous spots, yellowish next apex of primaries, irregular in size, lanseolete; primaries have a large sub-apical ferruginous patch on costal margin, another near inner angle, a broad black spot from costa covering the arc, two oval spot in cell placed transversely and sometimes confluent, two others in first and second median spaces, and a large sub-ovate spot on submedian interspace extending partly over the one next above. Secondaries have the entire costal margin brownish-black, a large irregular black patch on disk between upper branch of the sub-costal and the median nervure; a brownish-ferruginous patch at base of the upper median nervules; the whole extra-discal area suffused with ferruginous, passing imperceptibly into the marginal border; fringes fuscous, with a very little white in the emarginations.

Under side mostly in shades of black or black-brown, the entire surface, except where deep black prevails, covered with fine abbreviated streaks darker than the ground; apex of the primaries faintly tinted with olivaceous; costal mragin brown, with a few gray scales near apex, a whitish patch beyond extremity of cell and a smaller one nearer base; base of primaries brown, of secondaries brown next costa, black towards abdominal margin; the disks crossed by a common, broad, black band, very irregular in its exterior outline, on lower part of secondaries merging into the black basal area, outside the band, on primaries and upper part of secondaries, grayish-white for a little space, densely streaked, and beyond to margin blackish-brown; the extra-discal points nearly or quite lost on the dark ground; sub-marginal crescents black, obsolescent, often wanting altogether; in the cell of primaries three elongated, narrow, deep black spots, two of which lie along the costal nervure, separated by a very small interval, and each edged by a velvety black line; the third along median nervure, illy defined without such edging; the spot on disk of secondaries dead white, bent at right angles; the lower limb straight, thick abruptly sloping to a point by the cutting away of its upper side; the upper branch narrower, slightly curved, nearly as wide at top as elsewhere and ending bluntly; fringes with the white area more extended than on upper side.

Body above black, covered with ferruginous hairs, below black, sometimes with a gray shade; legs gray-brown, palpi black at base and in front, with whitish hairs at sides, ferruginous at top; antennae black above, fulvous below; club black, fulvous at tip.

Female expands from 2.1 to 2 3 inches. In shape very like the male; upper side dull yellow-fulvous, the spots large; under side more brown than black, the extra-discal area to margin pretty uniform in shade, the ground being dark gray, nearly lost in the denseness of the brown streaks; sub-marginal points and crescents obsolescent; silver mark of same shape as in the male, often quite as heavy.

Early Stages—Larva unknown.

Distribution—Found in California, Washington, Vancouver Island, and Montana. We have not taken it.

THE TORTISE SHELLS.

Genus Eugonia Hubner. Fig. 71.

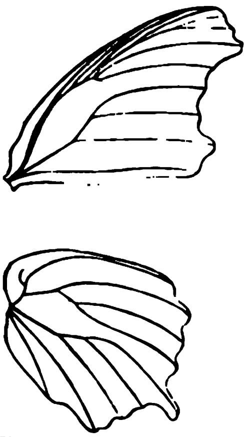


Fig. 71. Venation of Eugonia J. album.

Butterfly—Medium sized insects, wings above generally some shade of black or brown, marked with red, yellow or orange. The head is moderately large, eyes hairy, palpi more or less scaled, prothoracic legs feeble and hairy. The cut shows the wing venation. The cell of the primaries may or many not be closed. The cell of the secondaries is open. The fore wings have the outer margins more or less deeply excavated between the extremities of the upper radial and the first meaian veins, at which points the wings are rather strongly produced The hind wings have the outer margin denticulate, strongly produced at the extremity of the third median nervule.

Early Stages—The eggs are short, ovoid, broader at the base, ridged at the summit. They are generally laid in large clusters upon the twigs of the food plant. The mature caterpillar is cylindrical, adorned with long, branching spines in longitudinal rows. It feeds upon the elm, willow, and poplar. The insects hibernate in the imago form, and are among the first to appear in the spring.

THE COMPTON TORTISE. Eugonia j. album, Boisduval Leconte. Fig. 72.

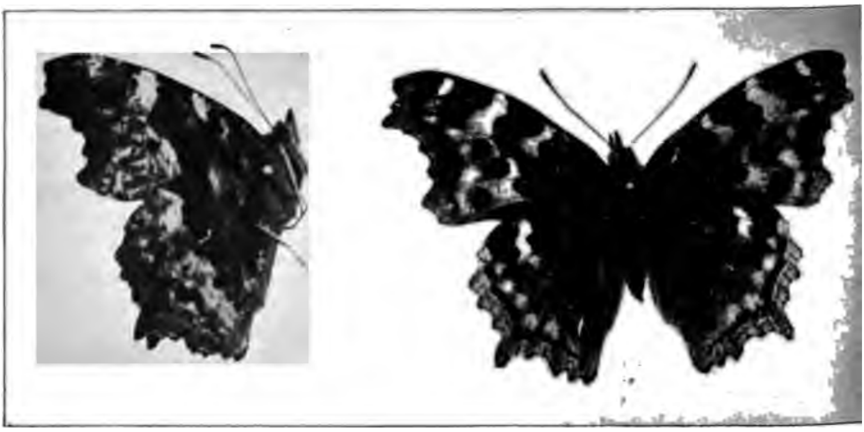


Fig. 72. **Eugonia j. album.**

Butterfly—Expanse of wings, 2.50 to 2.75 in., 64 to 70 mm. Upper surface dull yellowish, dusky at base, washed more or less with rusty brown, especially on the basal half. Outer border of fore wings dull black with a double crenate line and two more or less large costal bars—one at the end of the cell, and the other between the cell and a white sub-apical patch; a black spot in the cell with three black spots below the cell, the one nearest the base of the wing quite large.

The hind wings have a black and brown border a little within the margin, the yellow outside sprinkled with brown atoms; a large black space below the costa, beyond which is a whitish patch.

Under side grayish brown, the usual darker band across the middle which on the hind wings is but little darker than the base; beyond this greenish white the whole surface finely reticulated with brown lines. There are the usual three elongate patches edged with dark brown in the cell of the fore wings. The submarginal row of ashy-blue lunules between these and the median band. The lunules do not reach the apex of the fore wings.

Early Stages—The mature larva is two inches, 50 mm. long, head with black markings on the sides, thickly set with little points and with short spines; somewhat cordate, the vertices surmounted by two shining black, thick spines, verticellated near the tip. The dorsal and subdorsal rows of spines shining black except at the base, which is reddish, with long branches, those of the anterior joints more thickly branched than the others. The super- and sub-stigmatted row reddish tipped with black.

The chrysallis is one inch long, of a beautiful color, delicately reticulated, with six golden spots on the back.

The food-plant is not known, but Prof. Fernald's surmise is that it may be willow. The butterfly hibernates, the new brood appearing about the middle of August.

Distribution—It is a northern form, being found in Pennsylvania upon the summits of the Alleghanies, and thence northward to Labrador on the east and Alaska on the west. It is always a rather scarce insect, says Holland. See note accompanying the genus. It is occasionally found at Missoula. Around the biological laboratory at Flathead lake it is often captured. At Schultz's cabin, which is along Aeneas trail over the Swan range, it is quite common, but Bond's cabin at Swan lake is the greatest collecting field in the state, perhaps in the country, for this species. Hundreds were taken here in two or three days in August. 1903. Wiley has one specimen from Miles City, July 15, 1892.

THE CALIFORNIA TORTOISE-SHELL, Eugonia californica, Boisduval.

Fig. 73.

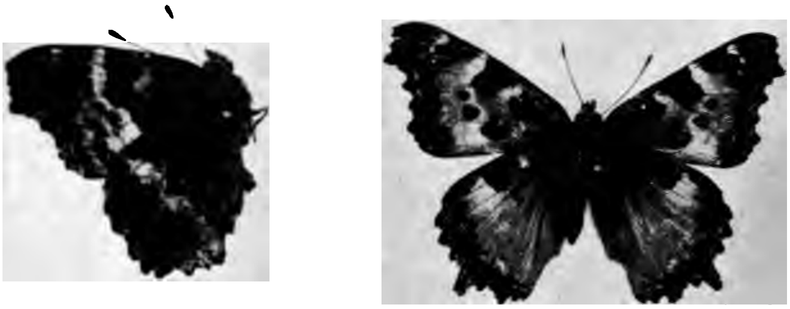


Fig. 73. **Eugonia californica.**

Butterfly—Similar in general shape and appearance to **E. J. album**, but easily distinguished by the following peculiarities.

Color—Deep fulvous, spotted with black and having a black border. A black bar across the cell. On the underside dark brown, with a light border. The entire surface marked with fine lines. Expanse 2.00-2.25 inches, 51-57 mm.

Early Stages—The caterpillar feeds upon Ceanothus.

Distribution—It ranges from Colorado to California and as far north as Oregon, east to Miles City.

In 1900 **californica** was quite common up Hell Gate canyon near Missoula, many having been brought in late in May and early in June. August 20 it was still abundant at Swan Lake, giving evidence of two broods. It is not infrequent about Flathead lake, and evidently covers much unexplored western territory. Wiley reports it at Miles City In 1903 the earliest butterfly at Missoula was a **californica** taken February 19.

Eugonia J-Album in Western Montana.

"This insect is generally rare," writes Holland in his Butterfly Book. In several places in the western part of the state it may be taken in large numbers. At the upper end of Echo Lake, next to the Swan range, we have never failed to take it during our annual pilgramages to the summit of the range, MacDougal mountain. The old submerged cabin in the lake is a safe refuge. The cabin on the bank, now deserted, offers a safe retreat from enemies save the human entomologist, who finds here a great opportunity for capturing a rare specimen.

But it is at Swan Lake that **Eugonia J. album** flourishes in its splendor, magnificence and abundance. This beautiful little sheet of water lies cradled between the Swan and Mission ranges. At its upper end, on the eastern shore, are three cabins. The cabins are along the trail which leads up the lake, through the Swan river forest above the lake to the wagon road leading to Ovando, Missoula, and other places. A clearing of a few acres is around the cabins. Dense woods come to the clearings on all sides. In August the sun is intensely hot in the small open patches about the cabins. About these small log huts, seeking the shade of the rude porch or the interior of the stable, **Eugonia J. album** was to be had by the dozens. They would alight on the logs of the buidings, the stumps in the clearing, the fence rails, and the bark of the living trees. After alighting they remained perfectly quiet, so that one could carefully adjust the net over them, and with a quick jerk scoop them into the net. In this way a half dozen were often fluttering in the net at once. It was practically impossible to capture them on the wing, so quickly can they dodge and so swiftly do they fly.

When the butterflies alighted on the bark of the fir, cottonwood or birch, upon which they were generally taken, they were almost invisible. It was interesting to see them remain in the same quiet attitude on the top rail of a fence or the skinned log in the cabin, where they were very conspicuous, as on the trunk of a tree where they were invisible. Protective resemblance was in this species beautifully illustrated, and those who made the trip to Swan Lake in August, 1903, will not soon forget how the insects were controlled by instinct.

Other insects were out, and were captured. **Eugonia californica** was much less common than **E. J. album**, while an occasional **Polygonia faunus** was picked up. The western admiral was rare. Robberflies were out in abundance, as were also bees. Two species of flies were captured which mimic bees, and a dozen species of butterflies were found in greater or less abundance. Nowhere in Montana have we seen more butterflies at one place or captured more in one day than at Groom's cabin at the upper end of Swan Lake, when the species under discussion was taken in such abundance.

In early August, 1904, another visit was made to the cabins at Swan Lake. **J. Album** was in much less abundance, and difficult to take because of the great number of baldfaced hornets which seemed to have possession. Not a **Polygonia** was seen.

In 1905 **album** was carce. Its place was taken by the bald-faced hornet. This latter insect practically prevented butterfly collecting.

MOUNTAIN SWARMING OF VANESSA CALIFORNICA.

During an ascent of Mount Shasta, made in August, 1889, a most interesting occurrence was noted in the flight of countless myriads of butterflies (**Vanessa californica**) at an altitude far above snow-line.

In our early morning climb of August 29, of the above year, we had left our horses at half past 4 o'clock, at what is known as "Horse Camp," at very near snowline, where there were many small snowfields close about us. Our progress was very slow and tedious, being all of the time over loose, sliding fragmentary rocks, or the almost smooth, hard-frozen surface of the icy snow, and which latter did not soften till long after the sun had swung high enough to shine full upon it. Some little time after daylight, but long before we could see the sun, as he was hidden from us by the high crest of a sharp ridge on the southwest aspect of the mountain (our ascent being made from Sissons, west of the mountain), a few signs of insect life were seen in the shape of "snow-fleas," two or three large-winged grasshoppers, and, occasionally at first, a butterfly. The last two were stiffened by the cold as if they were there from the day previous. The latter insect increased much in numbers as we ascended, and were many of them found in among and under the loose stones as well as a few upon them.

At perhaps half past 9 we came to a point upon which the sun had long been shining, and here they were flying in the air, the flight being in a south-easterly direction. From here they seemed to increase very rapidly in numbers up the remainder of the ascent to well toward the summit. The latter was reached at 11:20 A. M.; the temperature was noted at 42 Fah. in the open air. We remained here about a half hour, then passed down by way of the Hot Sulphur Springs, and then out on the southerly face of the mountain. We again encountered our beautiful friends at not farther than six or eight hundred feet below the extreme peak, and now in countless numbers, filling the air with their flashing wings, and all passing in the same direction as observed during the ascent—towards the southeast. This strange sight continued until we seemed to pass below them, at an altitude of between 11,000 and 12,000 feet. The fact of its being a continuous flight of these insects across the mountain in one direction during the warm part of the day—a period of nearly five hours—is beyond question. That it was in progress one or more days previous to that upon which I observed it is an easy deduction from the fact of the numbers of the insects found among the rocks and stones while yet stiffened by the cold of the night air. How much longer it may have continued I had no means of knowing.

Where they could have come from, in such vast numbers, and what brought them to such a high altitude, is of course a matter of pure speculation.

I had no means of preserving specimens of these insects except to place them between the leaves of a notebook; in this way some were kept for identification. A gentleman whom I met a few days later pronounced the species to be Vanessa milberti, but after presentation of the account of the flight, with the specimens, before the Biological Society of Washington it was determined for me by Mr. Howard as Vanessa californica.—C. L. Hopkins in Insect Life.

THE MOURNING CLOAK; THE CAMBERWELL BEAUTY, Euvanessa antiopa, Linnaeus. Fig. 75.

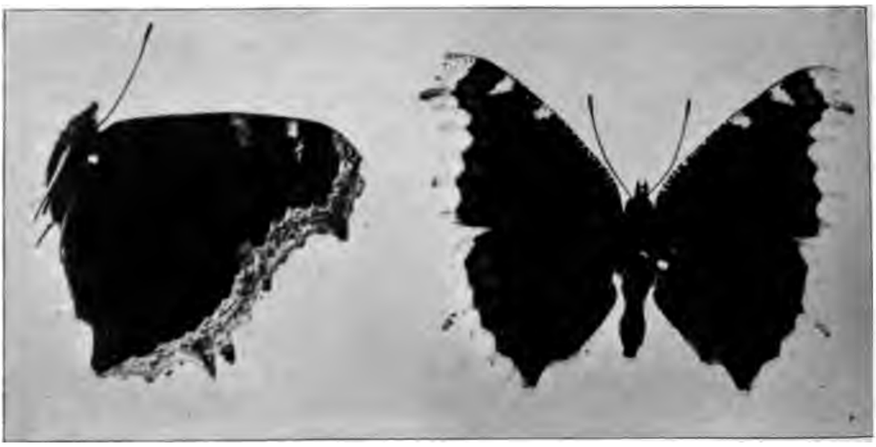


Fig. 75. **Euvanessa antiopa**, upper and lower surfaces of the wings.

Butterfly—Expanse of wings, 2.5 to 3.5 inches, 64 to 90 mm.

Upper surface rich dark maroon-brown the border yellow sprinkled with brown, and preceded by a black band containing a row of blue spots. The costa is mottled with yellow and contains two yellow patches.

Under surface traversed by numerous fine black abbreviated lines, the outer margin pale buff sprinkled with brown, and preceded by a series of confluent gray, blue-black-edged lunules.

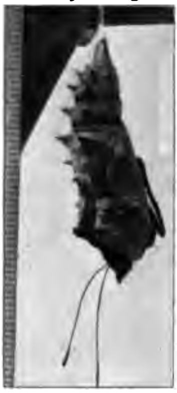


Fig. 74. Euvanessa antiopa, just emerging from the chrysalis.

Early Stages—The female deposits the eggs in a cluster round the twigs of willow, elms, or poplar near the petiole of a leaf, upon which the young larvae may feed. The mature larvae are two inches long, black, minutely dotted with white which gives them a grayish look; with a dorsal row of brick-red spots. Head black, roughened with small black tubercles. The spines on the body are black, rather long, slightly branching. There are four on joints 2 and 3, six on joints 4 and 5, and seven each on joints 6 to 12. The last joint has two pairs of short spines, one behind the other.

The chrysallis is dark brown or gray, with two rows of spines along the back of the abdomen, two on the head in front, three on the edge of the wing-covers on each side, and a thin prominence on the middle of the thorax.

Distribution—Generally over the North Temperate Zone. It has been taken at Missoula, McDonald and Sinyaleamin lakes in the Mission mountains, Flathead lake, and Swan lake. At Missoula **antiopa** and **milberti** are the first signs of spring. Branedgee has collected it at Helena, Wiley at Miles City. It is a handsome ornament for a collection. Tolerably common in the mountains near Big Sandy. Collected by Coues along the 49th parallel in 1874.

Stridulation in Euvanessa Antiopa.

Although the sound made by this butterfly without doubt is the expression of certain emotions, be it of anger or of love, since it is not made by the emissions of the breath, we cannot, I think, consider it more than elementary voice, and in the present instance a singularly erratic development of its elements. It may be that

"In Lorranise ther notis be
Full swetir than in this contre,"

for English entomologists are I believe, generally of opinion that the sound which butterflies make is caused by their rubbing their wings together in their ardor. In the Entomologist's Monthly Magazine for February, 1877, page 208, I find the following notice:

"In 1872, a female antiopa came into my possession in a hibernating condition, and in that state she would, when disturbed, partially expand her wings, and at the same times was produced a grating sound, which seemed to come from the base of the wings.—A. H. Jones, Shrublands, Eltham."

Let anyone now take a dried specimen of this butterfly from the cabinet and grasping the fore wing by its front edge rub it backwards and forwards over the hinder one, so that the bases meet, but being at the same time careful not to crumible the wings and so produce a false sound. We will then without fail hear the sweet secrets of antiopa, which are beautiful and delicate in expression, recalling the trickle of the brooklet.

I may notice that Vanessa butterflies are renowned and well-known as stridulators on account of their large size, but that nearly all butterflies rub their wings together when under the influence of the emotion of love, and since it is the result of friction to produce a striated surface, many of these smaller ones must have organs of sound too fine for human sense. My own researches have always been circumscribed from a want of adequate microscopic power.—A. H. Swinton in Insect Life.

MILBERT'S TORTOISE SHELL, Aglais milberti, Godart. Fig. 76.

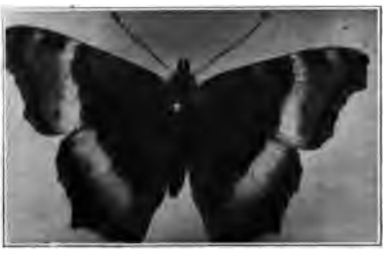


Fig. 76. **Aglais milberti.**

Butterfly—Expanse of wings 1.6-2.55 in., 40 to 65 mm. Upper surface brownish black, with a broad fulvous band between the middle and outer margin, paler on its inner edge. On the fore wings the pale band contains a black patch on the costa, with a white spot on one or both sides. There are two fulvous spots in the cell. The border is composed of two parts, the inner black, the outer a black brown, crenate line on each side of which it is a little paler. The black on the hind wing supports a row of violet lunules. Underside dark brown with the usual wavy lines and spots; the outer half yellowish brown with a submarginal of gray blue lunules which are black edged.

Larva—The mature larva is a little more than an inch long, with a black head sprinkled with minute whitish dots, from which spring pale hairs. The body is nearly black above, with small white dots and pale hairs, which give it a grayish color. The spines are arranged as in **antiopa**, and are black and branching. It has a greenish yellow lateral line above which is a broken line of brighter orange yellow shade. The larvae are found on the wild nettle, and there are two broods in a season.

Chrysalis—The chrysalis is .8 of an inch long, 20 mm., slightly angular, the frontal beaks short, conoidal; thoracis projection forming nearly a right angle; dorsal spines but little elevated.

Distribution—It ranges from the mountains of West Virginia northward to Nova Scotia and Newfoundland, thence westward to the Pacific.

This tortoise-shell butterfly is one of the first harbingers of spring. Uusually it is the first butterfly seen about Missoula, where it is rather common. It is usually quite abundant around the biological laboratory at Flathead Lake, but in the summer of 1903 but very few were seen. Brandegee has collected it at Helena, and Wiley reports it rare at Miles City. At Swan Lake it is occasionally seen, probably about the same in numbers as at Flathead Lake, owing to their close proximity. Coubeaux says it is very abundant all over the country about Big Sandy. Taken by Coues at Chief Mountain, August 22, 1874.

THE LADY BUTTERFLIES, Genus Vanessa, Doubleday. Fig. 77.

Butterfly—Medium-sized insects; the wings on the upper side are some shade of black or brown, marked with white, red or orange. Head rather large, eyes hairy, palpi more or less heavily scaled. The cut shows the venation of the wings. The outer margin of the wings is dentate. The wings are not angulate, as in vanessa, but are more rounded. The ornamentation of the under side tends to become ocellate, or marked by eye-like spots. Some are ocellate.

Egg—This is broadly ovoid, being much like the egg of the genus Vanessa.

Caterpillar—In its mature form it is covered with spines.

Chrysalis—It is much like Euvanessa.

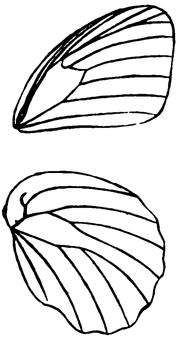


Fig. 77. Venation of vanessa.

Genus VANESSA.

Key to Species.

Ground color black, band on fore wings and outer margin of hind wings fulvous atalanta
Ground color fulvous. 2.
Five eyespots on underside of hind wings cardui.
Four distinct eyespots on hind wings; black bar across middle of the cell of the primaries; tawnier ground color than cardui caryae
Hind wings with two large ocelli underneath huntera

THE RED ADMIRAL. Vanessa atalanta, Linnaeus. Fig. 78.

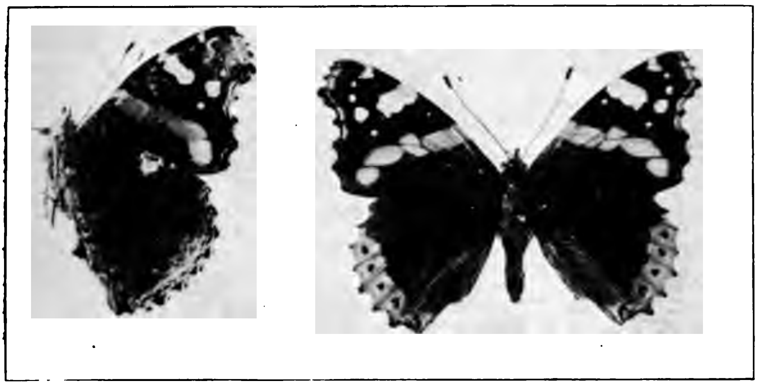


Fig. 78. **Vanessa atalanta.**

Butterfly—This butterfly is brown above, with a fulvous band on ie outer margin of the hind wings, containing brown spots. The fore ings are also crossed by a fulvous band, which begins at the posterior ngle and passes through the cell. There is a white bar beyond the ell, also a marginal row of about five spots, the fourth from the costa eing the largest. The spots of the upperside reappear on the underside, ut the brown is marbled with gray, blue and green and there is a subarginal row of spots on the hind wings. Expanse 2.00 to 2:25 inches, 1 to 57 mm.

Early Stages—The eggs are green, barrel shaped. The young larva greenish brown, and furnished with ten rows of black curved hairs. n reaching maturity it passes four moults. The mature larva is 1.3 in. ng, cylindrical enlarged in the middle and of a velvet black color, prinkled with fine velvet points. The chrysalis is from .85 to .95 of an nch long, cylindrical. The dorsal tubercles are gilded. The color is sually gray. The food plants are nettle and hop.

Distribution—It is found in the United States generally. During the mmer of 1903 it was taken sparingly at the Biological Station at Flatead Lake. It has not been seen at Missoula. It is not in the collecons of Wiley, Cooley or Brandegee, and must be very rare in the state. is reported by Dyar from the Kootenai country.

THE THISTLE BUTTERFLY or THE PAINTED LADY. Vanessa cardui. Linn. Fig. 79.

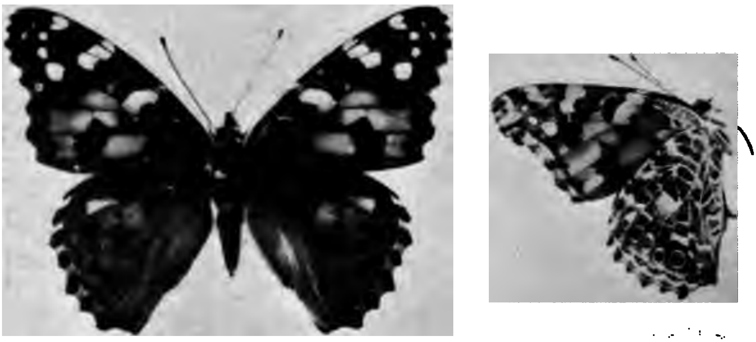


Fig. 79. **Vanessa cardui.**

Butterfly—Pyrameis cardui, or the Painted Lady, has an upper surface of fulvous color, the apical portion of the fore wings being black. There is a white bar in the apical black portion of the fore wings and a submarginal row of four white spots; the inner ones being the smaller. The underside of the fore wings is red except the apical part which is marked as above. The hind wings have a submarginal row of five black spots. Both wings have a border, the hind wings having a broken one. The underside of the hind wing is marbled with brown, gray and white. The ocelli contain blue. The inner row of the margin is blue or lilac. Expanse of wing 1.75 to 2.5 inches, 45 to 64 mm.

Early Stages—The mature larva is 1.5 in. long, cylindrical, rather robust. The general color is a delicate lilac. Between the joints are two lines of bright yellow. The space between the yellow occupied by two narrow black lines and one white one. There are seven rows of tubercles from which arise branching spines. The head is black, stigmata black with some black spots over the body.

Distribution—Most widely distributed of all known butterflies, being found in almost all parts of the temperate regions of the earth and in many tropical lands in both hemispheres. It is double brooded and hibernates in the butterfly state. Found all over Europe, North America, in Africa,—save in the dense jungles of the Congo.—in South America, in Australia and in many islands of the sea; at some times scarce and then at seasons it fairly swarms. (Holland.)

One of these swarms visited Montana in the spring of 1899. During late May and early June there were hundreds and thousands everywhere in the western part of the state, noted especially at Missoula and Helena. So abundant were they that they were noticed by all, and considerable alarm was felt by some lest there should occur later an outbreak of an insect pest. Happily this did not occur.

It abounds about the biological laboratory at Flathead lake, and specimens showing great variation have been captured. Brandegee has taken it at Helena and Wiley at Miles City. It is abundant in extreme ends of the state. Cooley reports it abundant at Bozeman. It seems to be everywhere one of the most common insects. It is known among entomologists to be the most widely distributed of all butterflies, so far as present knowledges goes. Its food plants are thistles, (Carduus), Urtica, (nettle), Onicus, (plumed thistle), and Altheca (marsh mallow). Coubeaux calls it abundantly around ..ig Sandy. Collected by Coues along the 4th parrallel in 1874.

THE WEST COAST LADY. Vanessa caryae, Hubner. Fig. 80.

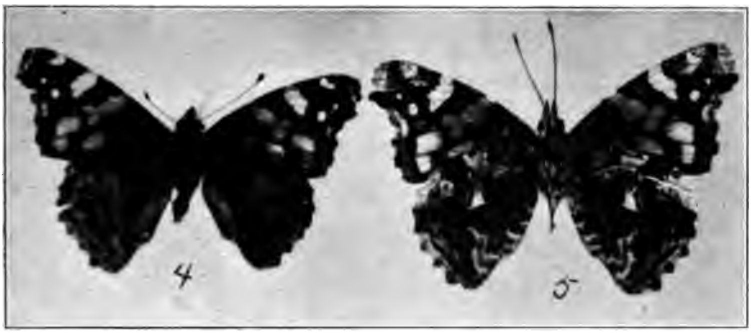


Fig. 80. **Vanessa caryae,** 4 upper, 5 lower surface.

Butterfly—It is distinguished from P. cardui by absence of the roseate tint peculiar to that species. It has a complete black bar across the cell in the primaries. Expanse 2.00 in.

Distribution—It ranges from Vancouver to Argentina; found as far east as Utah. Two specimens have been taken at Missoula. As it has been taken by no one else Missoula is perhaps as far east as it will be found.

HUNTER'S BUTTERFLY, Vanessa huntera, Fabricius.

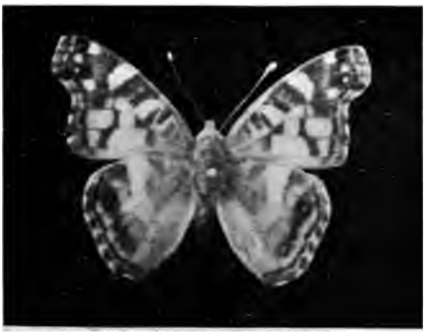


Fig. 80a. **Vanessa huntera,** natural size.

Butterfly—Expanse, 2.00 to 2.25 inches, 50 to 64 mm. Upper surface fulvous; a little tawny at base, the apical portion of the fore wings black, this continued as a border to the posterior angle. The apical black contains an oblique fulvous bar beyond the cell, and the submarginal dots as in **atalanta**, the first two blended, and one farther down in the fulvous. Besides this there are five triangular black marks, two of which are in the cell. The border of both wings consists of three more or less distinct lines, the inner on the hind wings in the form of a shade. The apical portion of the border on the fore wings is washed with lilac; and there is a gray-blue bar at the anal angle. Hind wings have a submarginal row of five black spots, the second and fifth pupiled with blue. Costa black.

The under side of fore wings is red, except the apical portion, which is marked as above. Hind wings marbled with brownish black and white, with two large ocelli. By these it is easily distinguished. The outer border is four black lines, with violet between the two inner.

Early Stages—The mature larva is 1.25 inches, 32 mm, long, the body velvety black, between the joints four transverse lines of pale yellow alternating with narrow black lines. The food plants are Gnaphalium, Antennaria, Artemisia, and allied species.

Distribution—From Nova Scotia to Mexico. In the state it is reported only by Campbell Carrington and William B. Logan, of the Expedition in 1871, locality not given.

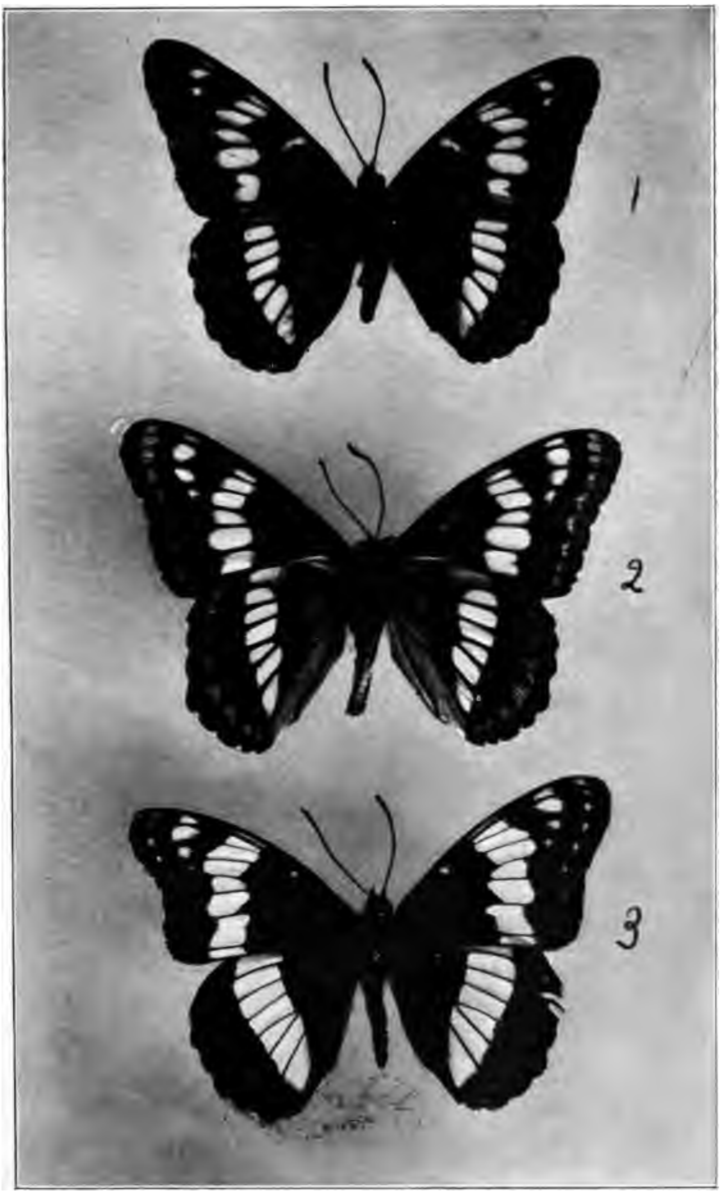
THE MONARCHS, Genus Basilarchia, Scudder.

Butterfly—Head large; the eyes are large and naked; the antennae moderately long, with a distinct club; palpi compact, stout, produced, densely scaled. The fore wings are sub-triangular, apex well rounded, the lower two-thirds of the outer margin slightly excavated. The first two sub-costal nervules arise before the end of the cell. The hind wings are rounded, crenulate.

Early Stages—Eggs nearly spherical, the surface pitted with large hexagonal cells. The mature caterpillar is cylindrical, the second segment with two prominent rugose club-shaped tubercles; they are strikingly mottled or spotted. Chrysalis suspended by a stout cremaster. They feed upon the leaves of various species of oak, birch, willow, or linden. Three species are found in the state, to be separated from each other by the following key.

Key to species.

1.	Ground color fulvous or mahogany	archippus
	Ground color black.	2.
2.	Both wings with broad white bands.	3.
	Wings without broad white bands.	astyanax.
3.	Yellowish white bar near the end of the cell of the fore wings, apex and upper margin, of the same, reddish.	lorquini
	Bar and red color absent, and a submarginal series of white spots present.	wiedemeyeri



3. **Basilarchia wiedemeyeri**; 2, lower surface, 1, upper surface of **Basilarchia lorquina.**

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TILDEN FOUNDATIONS.

THE VICEROY, Basilarchia archippus, Cramer.

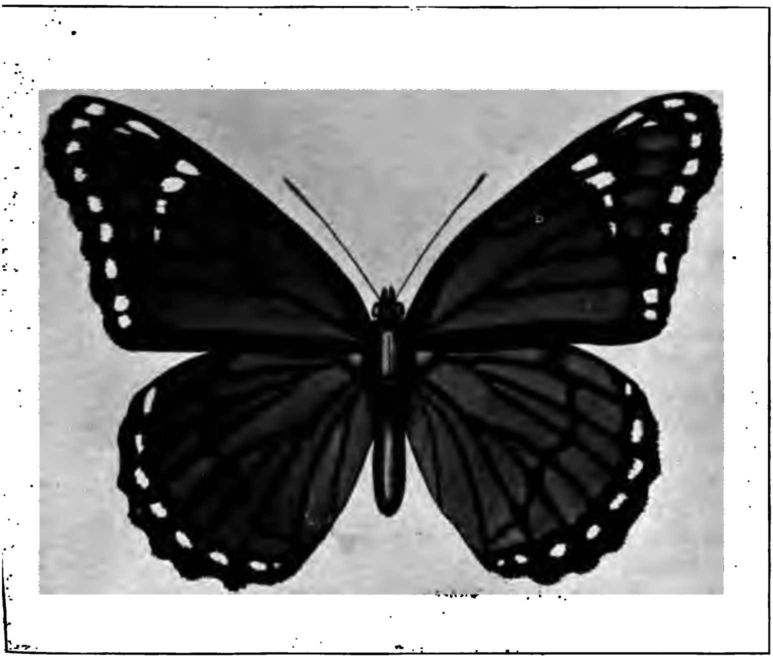

Fig. 81. **Basilarchia archippus,** From water color drawing by Mrs. Edith Ricker.

Butterfly—Upper surface fulvous, the lines black; on the fore wings dark triangular patch, containing three white spots on the costa beyond ıe cell, continued to the posterior angle in a narrow line. A black line osses the hind wings about two-thirds of the distance from the base. ıter border black containing a row of white spots, and there are two te-apical white spots; the lower one quite small. Underside similar upper, paler fulvous. The fringes are black, spotted with white.

Earley Stages—The larva feeds upon willow, popular, balm of gilead, en, and cottonwood. It is two or three brooded.

Distribution—Found over nearly the whole of the United States as west as the Sierra Nevada Mountains, and has been found sparingly n to the Pacific coast. near our northern boundaries.

B. archippus is injurious to the oak and to the wild plum.

This species mimics the Monarch butterfly Anosia plexippus, so ndant in the eastern states. The Monarch is sparingly found in the tern part, rather abundant east. The eastern milkweed is gaining oting along the railroads, and with it the Monarch is probably on the ease. The writer has not taken the Viceroy west of the range, but E. N. Brandegee has some specimens from Gold Creek, west of the ge, which he collected and which the writer has seen. Cooley re-s it as occasional near Bozeman, while Wiley calls it rare and local at Miles City. Douglass collected one specimen at Fish Creek.—beaux has collected it at Big Sandy.

WIEDEMEYER'S ADMIRAL Basilarchia wiedemeyeri, Edwards.

Plate VII. Fig. 3.

Butterfly—It may be distinguished from **B. lerquina** by its wings being crossed with white bars instead of cream ones, and the absence of a bar at the end of the cell and the yellow apex; it has a submarginal row of white spots on both wings. Expanse 3.00 inches, 77 mm.

Early Stages—Caterpillar feeds upon cottonwood.

Distribution—The insect is found on the Pacific slope and eastward to Montana, Nebraska and New Mexico.

We have not yet taken this species west of the Rocky Mountains, although it is not uncommon east of the range. Brandegee has collected it at Helena, Cooley at Mystic Lake, and Wiley at Miles City. Douglas found it at Madison lake and Jasper Mountain. Taken at Big Sandy by Coubeaux.

LORQUIN'S ADMIRAL, Basilarchia lorquini, Boisduval.

Plate VII, Fig. 1, upper, Fig. 2, lower surface.

Butterfly—Easily distinguished from all the other species of the genus by the yellowish white bar near the end of the cell of the fore wings, and the reddish color of the apex and upper margin of the same wings. Expanse, 2.25-2.75 in., 56 to 62 mm.

Caterpillar—The food plant of the caterpillar is poplar, willow, and the choke-cherry.

Distribution—This is a western species, quite common in most localities in the state west of the range. It is not known to occur east of the range. The University of Montana collection embraces specimens collected by Elrod at various places in the Mission Mountains, at Flathead and Swan lakes, at Missoula, and on Mt. Lo Lo.

BUTTER FLIES ON CHIMBORAZO.

"Even butterflies are found at sea at great distances from the coast, being carried there by the force of the wind when storms come off the land. In the same involuntary manner insects are transported into the upper regions of the atmosphere, 16,000 or 19,000 feet above the plains. The heated crust of the earth occasions an ascending vertical current of air, by which light bodies are borne upwards.

When Bonpland, Carlos Montufar and myself reached, on the 23rd of June, 1802, on the eastern declivity of the Chimborazo the height of 19,286 English feet, we saw winged insects fluttering around us. We could see that they were Dipteras, but it was impossible to catch the insects......The insects were flying at a height of about 18,226 feet...... Somewhat lower down, at about 2,600 toises (16,680), also therefore within the line of perpetual snow, Bonpland had seen yellow butterflies flying very near the ground.——Humboldt in "Aspects of Nature."

THE WOOD NYMPHS, THE MEADOW-BROWNS. SUBFAMILY Agapetinae.

The butterflies belonging to this subfamily are for the most part of medium size, and are generally obscure in color, being of some shade of brown or gray, though a few species are brightly colored. The markings consist almost entirely of eyelike spots, dark pupiled in the center with a point of lighter color, and ringed about with one or more light circles. They are possessed of a weak flight. Most of them are forest living insects, though a few inhabit the cold and bleak summits of mountains and grassy patches near the margins of streams in the far North.

The family includes chiefly brown butterflies whose markings consist almost entirely of eyelike spots. Some of the western species are brightly colored. The insects are easily recognized by their having some of the veins of the fore wings greatly swollen at the base.

The larvae are cylindrical, tapering more or less toward each end. The candal segment is bifurcated, a character that distinguishes them from all other American butterfly larvae excepting those of some of the emperors (Chlorippe).

The Chrysalids are rounded; in some cases the transformation takes place beneath rubbish on the ground without any preparation of cell or suspension of the body. Nearly fifty species have been described from America north of Mexico.

Key to Genera.

1.	Eyes very hairy	2.
	Eyes naked or nearly so	3.
2.	Outer margin of hind wings angled	Enodia
	Outer margin of hind wings evenly rounded	Satyrodes
3.	Upper surface of fore wings with eye spots	4.
	Upper surface of fore wings without eye spots	5.
4.	Spots ordered by some shade of red	Erebia, P. 113
	Spots bordered by some shade of yellow	Cercyonis, P. 105
	Spots light, color ochreous	Coenonympha, P. 114
	Spots bordered by white or gray	Neominois, P. 121
5.	Lower surface of hind wings mottled	Oeneis, P. 119

Genus CERCYONIS.
(The Wood Nymphs.)

Key to species.

1.	Fore wings with or without a buff band, but with two ocelli	alope
	No buff bands, fore wings with two occelli on fore wings and one on hind wings, both showing above	sylvestis, var. charon

THE COMMON WOOD NYMPH, Ceryonis alope Fabricus. Fig. 83, 84, 82.

Butterfly—Expanse of wings 1.75 to 2.00 inches, male. Upper surface blackish brown, darkest over the basal area; outer margin consisting of two fine parallel lines, a little within which is a black stripe. The fore

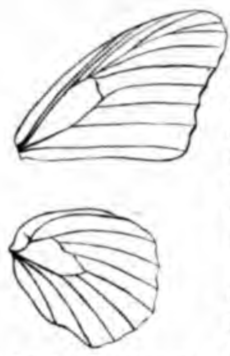

Fig. 82. Venation of cercyonis

wings have a transverse yellow band beyond the cell, sometimes a little ochraceous, and often more or less encroached upon by the brown ground. On this area are two ocelli, round, black, or variable size, and with or without a central point, which is white with blue scales. Behind the cell is a blackish indistinct sexual dash in the males. The hind wings have a small ocellus in a yellow ring near the anal angle (often wanting).

Underside yellow-brown; the band enlarged and of a paler color; the ocelli repeated, enlarged; the marginal lines distinct; the brown area covered with abbreviated darker streaks, which over the base and disks form somewhat concentric broken rings, limited without by a common dark stripe. On the fore wings it is irregularly sinuous from margin to margin, throwing out a rounded prominence against the cell, followed by a rounded sinus on the median interspace. Across the middle of the cell, and below it, a dark stripe; the extra discal area less streaked. The ocelli vary from none to six, the full number being most often present, disposed in two groups of three, the middle one of each group the largest; all black, rounded, in narrow yellow rings, and with white dots in the center edged by blue scales.

Female—This differs from the male in the band being generally broader, clearer, and well defined on both edges, the ocelli well developed, with occasionally additional black points on the hind wings corresponding to the ocelli on the under side. A larger percentage than of the males have no ocelli on the under side of the hind wings.

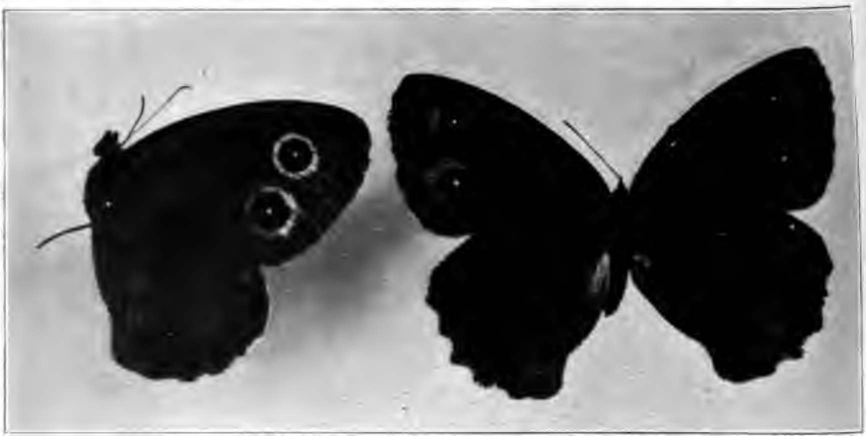

Fig. 83. **Cercyonis alope** var. **nephele**, right figure upper surface, left figure lower surface.

The above description applies to typical form alope. Variety **olympus,** Edwards, differs from the above as follows: The males are

lack. The ocelli are very small and without wings, but in some
there is a faint russet or yellowish tint about them, and perhaps
pace between them. On the under side the rings are russet or
us on both wings, and there is a perceptible bronze reflection
nderside of the hind wings, especially in the males.

form is said to occur from Illinois to the Rocky Mountains, and
abundantly in Montana. However, many specimens with the
ff band, as in typical alope are found also, see Fig. 85. **Olympus**
ele are now given as synonyms, so **nephele** occurs from New Eng-
he Rocky Mountains. Five varieties for this species are recog-

y **Stages**—The egg is conical, marked by about eighteen verti-
s, lemon-yellow in color, hatching in from fourteen to twenty-eight
he mature larva is 1.25 inches long, cylindrical, robust, thickest
iddle, with two sharp, conical, divergent tails; color yellow-green,
id green. Chrysalis is a little more than half an inch long, cylin-
The butterfly emerges in fourteen days. The larva feeds on
grass, and the butterfly is found mostly in the open fields or open

nephele—Largest of the forms, with buff bands. **Ariana** is also
Montana. This is a decidedly dwarfed form, and one that is
k. The ocelli are small and well defined.

species is abundant during July and August around Flathead
In searching for insects **nephele** skirts the roadside by the open
undulates through the woods in graceful flight. It becomes so
t that catching it becomes tame. The specimens show great
; the species is recognized as being exceedingly variable. At
, it is quite common; Brandegee has taken it at Gold Creek, and
t Miles City. Coubeaux has many specimens from Big Sandy.
llected from boopis at Chief Mountain July 21, 1874, a single spe-

RK WOOD NYMPH, Cercyonis sylvestris, var. charon. Edwards.
Fig. 84.

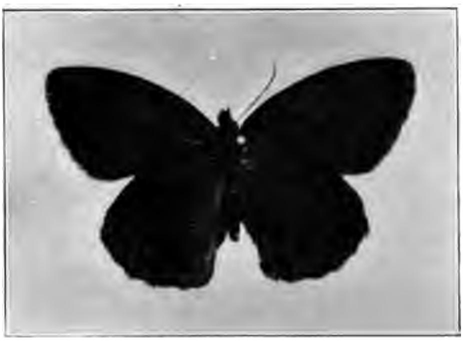

Fig. 84. **Carcyonis sylvestris, var. charon.**

Butterfly—Expanse of wings, 1.50 to 1.75 inches. The male is dark in color: the female is paler. There are two eye-spots on the fore wings in the usual location, indistinct on the upper, distinct on the lower side of the wings. The under sides of the wings are variable. In the type they are dark: in other specimens they are paler. They may or may not have ocelli on the secondaries. Both the fore and hind wings are abundantly and evenly marked by little striae, and crossed on either side of the median area by obscure, irregular, transverse dark lines, either one or both of which may be wanting in some specimens.

Early Stages—The caterpillar is green, cylindrical, tapering before and behind, marked with longitudinal pale-yellow lines. The chrysalis is green or black, striped with narrow white lines. The larva feeds on grasses.

Distribution—It is found in the Northwest, ranging from British Columbia as far as Mexico. In Montana it has been taken abundantly by Wiley at Miles City and Sandstone. Brandegee has taken it at Mt. Ascension near Helena. Allen has specimens from Dillon. Coues collected it in 1874 at Frenchman's river and Chief Mountain.

Collecting Butterflies in Montana.

ly 22, 1903, was a hot day. For several days the sun had been We were camped on the bank of Bigfork or Swan river at its to Flathead Lake. Our little laboratory, constructed escpecially door work, had been a scene of activity within, but no one could t long in the swamps or woods on account of the mosquitoes. For ys the little fellows had been especially persistent and villainous. as taken to be a sign that they would soon go, as they were starv- The sun dries up the ponds and they cannot drink nor lay eggs. tion becomes dry and parched, and does not supply nourishment. hot days, followed by a wind, and it was predicted they would go. ad come. Donning my coat containing papers, vials, corks, gloves, her necessary material, and accompanied by my dog, I started for lies.

or three Arygnnids had been seen, which were very much wanted. dozen other species were on the wing, but all species were doubt- . could not be named from seeing the specimen flying.

e field sought was the tamarack forest. The beautiful and stately filled the slope of the lake near the laboratory. An occasional s spruce or yellow pine added to the charm of the tamarck forest on road wound through the timber, affording a sunny opening in the insects love to sport. On either side the tall conifers towered ward. A breeze was blowing. The murmur of the pines as they l gently at their tops was music to the ear. The timber was not The sun filtered through the leaves and between the treetops, g alternate patches of light and shade. In the forest, therefore, thought the airy creatures would sport, where the sun's rays were ed by the shadow of trees, where the breeze would be less likely w against their delicate wings, and where they would be un- ed.

e delicate blue bells nodded in the underbrush. Mariposa lilies n the wane, but an occasional late one showed its delicate cream l perianth here and there. The twin flower was in bloom, making et where other vegetation was lacking. Service berries were ripe, e-black berries hanging in clusters from every bush. Spiraea was us, just coming into full bloom. A fringe of rock maple, dogwood, and service berry lined the road, while through the timber they cattered in great profusion.

was a day for birds. The brilliant plumage of the Louisiana tan- ashed in the sunshine as he flew from tree to tree. The call of the n Phebe was heard on every side. The long-tailed chichadee y sang from the bushes by the roadside. Upon an old bole a flicker lling to his mate, and alternately with his call drumming loudly dead tree. While sitting on a log and drinking in the sweetness bird music mingling with the sighing of the pines the loud call of the pileated woodpecker was heard in the distance; for this shy and handsome bird, the largest of our woodpeckers, is still not uncommon in the woods of Montana. I could not mention all the birds seen and heard. One hundred and forty species have been found in this vicinity. On that day the woods were alive with birds, sweet with their melody and with the odor of flowers. It was a walk of solitude, but I was by no means alone.

In a thick cluster of service berry my dog flushed a ruffed grouse with young. The little fellows could fly a little, and would rise into the top of a little birch or alder and pipe their alarm in great consternation. Their somber coats blended beautifully with the surroundings. If one saw a bird alight it was plainly visible. But when once the eye was turned elsewhere and returned to the spot the motionless bird blended with the light and shadow of the forest and with the bark of the trees. Had the little fellows remained quiet they might have passed unnoticed. They will learn, if some pot hunter does not kill them too early. The mother flutters around and makes a great fuss, while the young are scurrying away to places of safety.

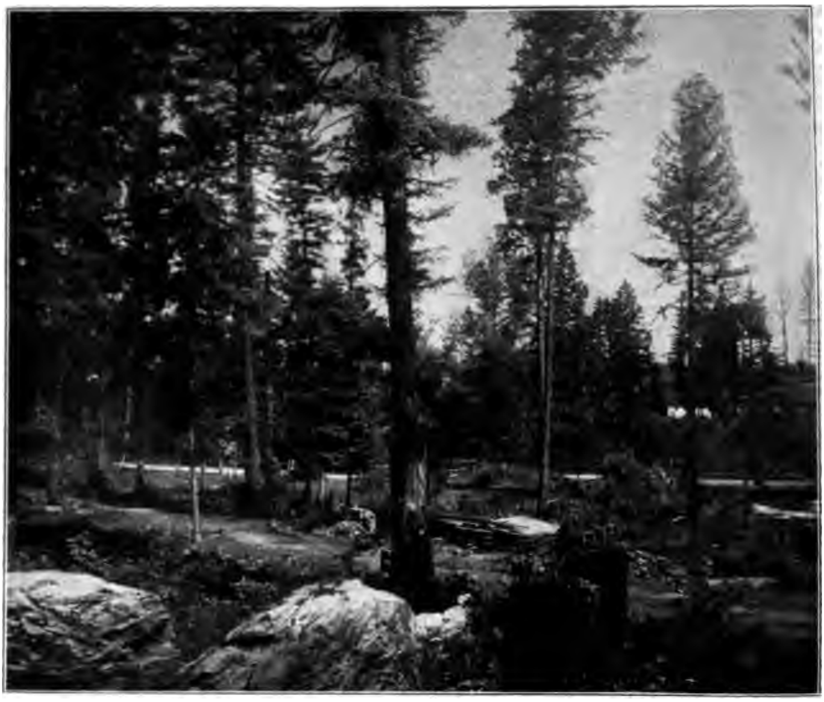

Fig. 85. Where Leto abounds, near the University of Montana Biological Station, upper end of Flathead Lake.

Scarcely had I left the laboratory when a beautiful Eurymus was seen flying over the bushes by the river bank at the entrance to the forest. Occasionally the delicate butterfly was seen, and I longed to have it.

Carefully I followed until the time was favorable for a sweep, when it was safely landed, much to my delight. Eurymus alexandra is not abundant here, but is often seen sailing gracefully over the tops of the dense bushes, out of reach but aggravatingly near. It was a perfect specimen, the only one seen or taken during the day.

I started before two. Along the road I went slowly, seeking the Argynnids. They were out. Such beautiful and dainty creatures they are. Leto was out in all its glory, but my captures were few. I simply could not do it. I was too awkward, slow, or something. They would not rest. Again and again their course would be near me and I would try, only to fail with an AH, and sigh of regret. Beautiful, dainty, delicate creatures, sporting in the open forest, flitting from open sunshine where the resplendent colors show in all their glory to the shadow of the forest where they may have a little respite. Their gaudy colors make them conspicuous a long distance off, and their large size makes it possible to detect them and distinguish them from others. Of the size of cybele of the east, which was my early delight, it lends a charm to the forest superior in some respects to that given by music of birds or odor of flowers. Gorgeous in array, gentle in movements, short of life, its life history unknown, what wonder that it has charm. The day was too hot for Leto to be in the open. I sought, but in vain. A return to the forest brought its company. Its flight is rapid and undulating. Rarely did it rest. Pursuit into the forest beyond the road was impossible because of brush, fallen logs, stumps and stones. Again and again I made a desperate sweep for a dark female or a more brilliant male. Thrice was I successful, but many times did I fail. But one sweep was granted. With the swish of the net through the air it was off in that peculiar zigzag course common to most butterflies, the angles of flight and the lines of flight as sharp and as numerous as the zigzag lines on the wing. It was not so abundant as formerly, for annually it has been taken near the laboratory for five seasons.

Other Argynnids were out. Hesperis and one I took to be atlantis, but which may prove to be different, were on the wing. The time to take pie is when it is passing. The time to take butterflies is when they are to be had. There is no more fatal error than to fail to take specimens because they are plentiful. They may not be so to-morrow. Every naturalist will no doubt recall irreparable losses because he failed to take specimens when they were to be had, but delayed for a more convenint season.

Atlantis was abundant. It is not so large nor so gorgeous as Leto, but is nevertheless beautiful. The underside of the species captured is dark buff with a slight submarginal band. It was abundant. It seemed to be especially fond of resting on Spiraca lucida. It rested often, and was not difficult to capture. The afternoon's catch resulted in 23 specimens of this and Hesperis. Atlantis was frequently interrupted in its rest on Spiraea lucida by Phyciodes tharos. Whenever a tharos was near it would invariably fly to the atlantis on the shrub. They would arise together and circle about before separating. Frequently the two were taken together. Tharos was invariably the aggressor. Whether it dislikes Atlantis or not was not apparent. It appeared more a curiosity move, but was not displayed toward the others.

Phyciodes tharos was abundant, and had been several days. Light, graceful and delicate, it rested airily on the broad white umbels of the Spiraca, when it would spread its wings to their fullest extent and fan them gently up and down. Its flight is more graceful and undulating than that of the Argynnids. It moves more slowly, keeps in the open, and for that reason was not difficult to capture. It was taken while waiting for others to appear.

Lycaona meliasa, the orange-margined blue, was less abundant along the roadside than on former days. It is a delicate little butterfly of wondrous beauty in color. It expands only about an inch. The males are blue-violet above with a delicate fringe or border of white scales to the wings. The female is dark brown with eye spots on the wing margins, surrounded by orange, giving the appearance of an orange band. It is underneath that the gorgeous colors appear. The spots with their border of gold and dust of silver, on a light grey background, and set out in contrast to the pure white brush like margin, call for admiration from all. Along the roadside they slowly flitted, mostly males, but now and then a female, occasionally seeming to hobnob with **tharos,** but always in graceful contrast to the more swiftly moving **Argynnids.** They were easy to take, but previously many had been captured.

A single Lorquin's admiral **Basilachia lorquina,** was captured as it was being gently wafted along a side road by the breeze.

Down among the red cedars along the rocky lake shore a female **Parnassius smintheus** was resting on a weed. She was royal in her array of delicate red, creamy white and drab gray. Upon the hilltop one must usually search for **smintheus,** for it is an alpine species, among the rocky summits where grow the sedum and saxifrages. It is rather suprising to find it at the level of the lake, about 2,900 feet, yet on several previous occasions it has been seen and captured.

Shortly after four in the afternon the trees were casting longer shadows, and already the cool of evening was being felt in the woods. The sun in the insects' god. When it shines all is life and activity. The whirr of the bettle's wings is heard, and the bumble bee hums from flower to flower, flies and gnats fill the air, dragonflies and damselflies skim the surface of the water, and butterflies disport themselves on airy wing. But when a passing cloud obscures the sun, or evening approaches, every form of insect life, except the mosquito and gnats, seems to feel the depression, and goes to cover. Where or what the cover is, who can tell? Two hours of brief collecting, and the work of the afternoon was over. The net result was forty butterflies and two moths, embracing the following species: **Colias alexandra, Argynnis atlantis,** abundant; **Argynnis leto,** less common; **Lycaena melissa,** quite common; **Phyciodes tharos,** common; **Basilarchia lorquina,** a single specimen; **Parnassius sminthcus,** a single specimen; **Argynnis hesperis,** rare; a small black butterfly, of undeterminable species, two specimens; total, forty specimens, eight species.

This was a good day. Many and many a day in Montana has resulted in a third of this catch. Both species and specimens are lacking in

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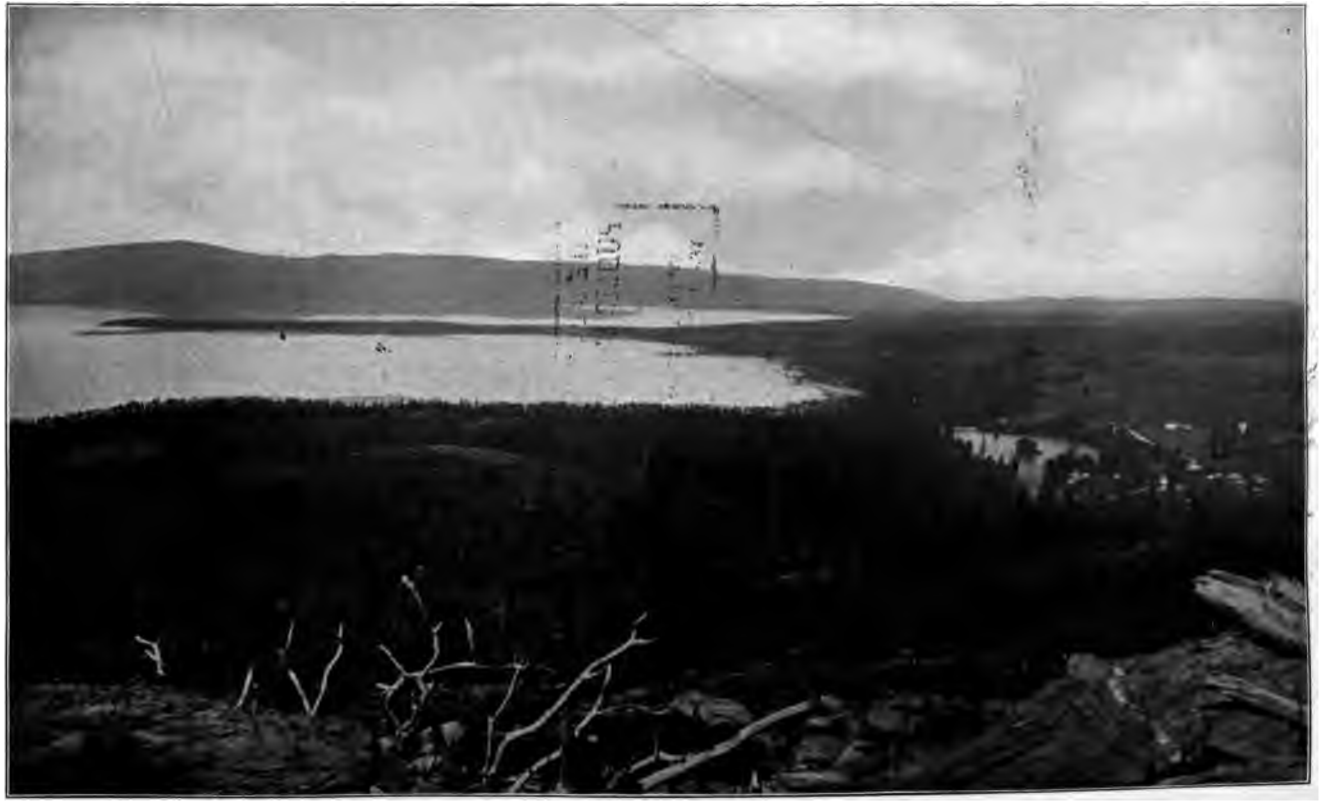

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is compared with collecting in my boyhood days, when I used ɜm up on the common or in the clover meadows in much greater

ext afternoon I tried again. The sky was obscured by light mer clouds, which later thickened for rain. **Atlantis** was some , and but a few were seen. **Leto** was very scarce, not one **Melissa** was yet in numbers, largely females whereas the ıe previous day was largely of males. **Tharos** was still in evi- single **Satyrus olympus** was added to the collection. Not a was in sight, not an admiral. A male **Colias alexandra** has- a the road to the bushes and eluded capture. It was a close poor catch.

bove is typical of good days in Western Montana. Wylie com- erly of the scarcity of butterflies in the eastern end. And yet is not without its charm and its reward. The field is new, ɔwn species lends zest to the search. "It isn't this not that, it omething new," is interesting and cheerful to hear. It shows er is thinking. And the great state, with its wealth of life, the ambitious entomologist who may be the first in his locality, m a rich if not prolific field. To the collector will come a love oods and fields. They will not be places of solitude, for there d friends, and will commune with nature in that manner which richest reward, when he is alone. He will feel the thrill of joy lding in his grasp a new find, for new they must be for years will be the pleasure, perhaps, of finding something new about ıdant species, for "Unknown" is yet written after many species ntioned. Nay, perhaps his small collection may be the humble of a larger work, leading to broad fields and to the fascination nes to him whose horizon is broad, widening with each day's ited only by physical limitations. Love for the humble little of the air, love for the beautiful in nature, as revealed in their nentations, love for nature itself, with a reaction upon the in- naking him more appreciative, more happy, and more contented, e final reward of the young collector.

M. J. E.

font., July 23, 1903.

Genus EREBIA, Dalman.

"The Alpines."

Key to Species.

Wings dark brown, ocelli pupiled with white and surrounded with red. epipsodea.

THE COMMON ALPINE, Erebia epipsodea, Butler.

Fig. 86, 87.

Butterfly—The wings are dark brown, almost black, pupiled with white, and broadly surrounded with red near the outer margin of the fore wings, and with three or four ocelli on the upper side of the hind wings. The spots on the upper side reappear on the under side, and in addition the hind wings are covered by a broad, curved, median blackish band.

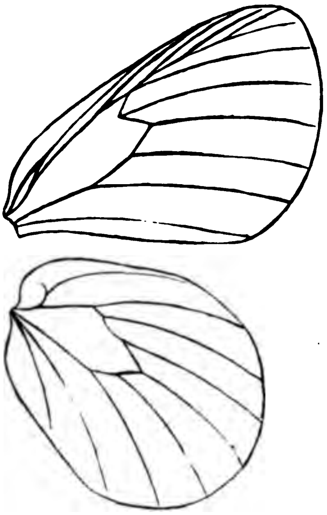


Fig. 86. Venation of Erebia epipsodea

Early Stages—The caterpillar feeds on grasses.

Distribution—It ranges from New Mexico (at high elevations) northward to Alaska. It is common on the mountains of British Columbia. The collection in the University of Montana contains specimens from Sinyaleamin lake and McDonald lake in the Mission Mountains, Flathead Indian Reservation, the Tobacco Root range, Geyser Basin and Missoula.

It has been collected by Brandegee at Helena, and reported common. It has been taken by Cooley at East Flathead in Park county, at Shields river, Park county, at elevation 6,400 feet, at Mystic lake, Gallatin county, at 6,700 feet, and at Bozeman.

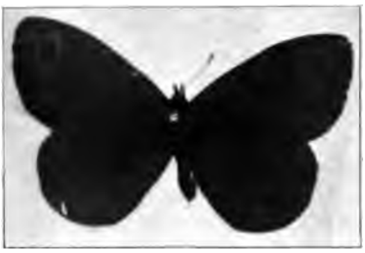


Fig. 88. **Erebia epipsodea**, lower surface.

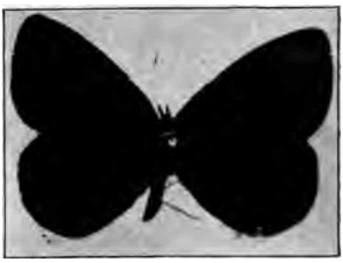


Fig. 87. **Erebia epipsodea**, upper side.

This butterfly is one of the early spring insects. The earliest about Missoula are **Aglais milberti** and **Eugonia californica**. Before the hot days come on **Erebia epipsodea** seems to be at its best. The last of May and the first days of June are the times when it is at its best. Its flight is like **Cercyon**, and the species is easily recognized by its flight.

Genus COENONYMPHA, Westwood.

The Ringlets.

Small Butterflies. The costal, median and sub-median veins are all strongly swollen, as may be seen in figure 89. The palpi are very heavily clothed with hairs, the last joint quite long and porrect. The antennae are short, delicate, gradually but distinctly clubbed. The eyes are naked. Both wings on the outer margin are evenly rounded.

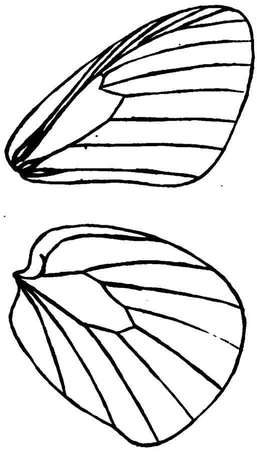


Fig. 89. Venation of Coenonympha.

This genus is distributed throughout the temperate regions both of the old and new world, and includes in our fauna a number of forms, the most of which are peculiar to the Pacific coast. They are very variable as to the number of spots and ocelli, and vary greatly in the color of the under side. It is no infrequent thing to find the ocelli and spots differing on the two sides of the same insect.

Key to species.

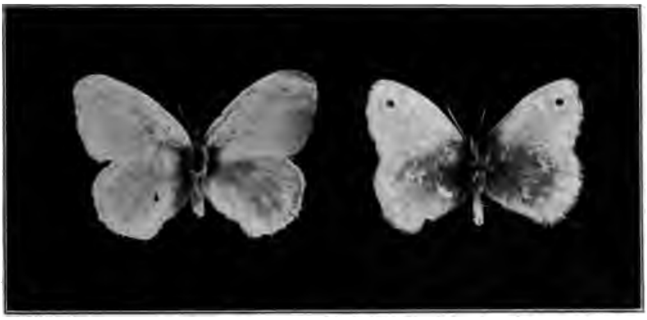
Upper side bright glossy ochre-yellow; no markings above save by the transparency of the wings ochracea

Upper side fuscous, immaculate; under side a shade paler, much irrorated with gray scales. haydeni

Upper side pale ochre-yellow, immaculate elko

Upper side ochrey-brown, lighter in the disk of all wings. tiphon, var. laidon

THE OCHRE RINGLET. Coenonympha ochracea, Edwards. Figs. 90 and 91.



Figs. 90 and 91, upper and lower surfaces of Coenonympha ochracea.

the hind margin; abdominal margin and base dark gray; near the hind margin and parallel to it is a series of six black dots, sometimes obsolete, usually with white pupil and broad yellow iris; near the base two irregular pale brown spots, and midway between the base and hind margin a sinuous interrupted ray of same color, extending nearly across the wing. Female like the male.

Early Stages—Unknown.

Distribution—Ochracea has a wide range, from Lake Winnipeg in British Columbia to Kansas and west to California.

This dainty little insect is abundant about Missoula in early spring. In May and early June it sports along the open hillsides, being most abundant in mountain gullies where moisture lingers, or along the banks of streams.

The university collection embraces specimens from McDonald lake in the Mission Mountains, Missoula, New Chicago, the Tobacco Root range, and the Ruby Mountains. It is common about Helena according to Brandegee. Wiley has it in his collection from Miles City, and Cooley has collected it at Forsyth and Bozeman. Coubeaux reports it moderately common in Bear Paw Mountains. Coues collected it along the 49th parallel in 1874.

Remarks:—Dr. Henry Skinner, in his revision of the American species of the genus Coenonumpha, Trans. Amer. Ent. Soc., Vol. XXVI, says of this species: "That is quite a variable species. The upper side differs very much in different specimens in regard to the distinctness with which the spots below show through on the upper side. The color of this species, in conjunction with the distinct ocellus on the premaries below, serve to distinguish it from all others." He calls C. brenda Edwards a synonym of C. ochracea, and says it is only a much spotted ochracea. "If we give names to all the variations of ochracea we would have six names for the species."

THE RINGLESS RINGLET. Coenonympha elko, Edwards.

Butterfly, Maîe—Expanse, .95 to 1.00 inch, 25 mm.

Upper side pale ochre-yellow, immaculate; fringes concolored. Upper side of primaries nearly same ochre-yellow over basal area and part of disk, limited without by a slightly sinuous and crenated edge of deeper color, much as in the allied species; outside this, slightly ochraceous next the inner angle, but yellow-buff over apical area. The secondaries have the basal area uniform grey-brown, the outline distinct and in strong contrast with the remainder of the wing which is yellow-buff. Very slightly gray; the outline is irregularly crenated, with a deep sinus on the upper sub-costal interspace, and another on the lower disco-cellular interspace.

Female—Expands 1.00 to 1.02 inches. Upper side like the male. Beneath, the area just outside the crenated edging on disk of primaries is yellow for a little distance, then tinted ochraceous to the margin, in one example a minute black dot in the disco-cellular interspace with white center, in another no dot; secondaries as in male, basal area one shade of gray, with distinct crenated outline, and beyond a yellow or buff ground to the margin, very little dusted with gray.

Distribution—It occurs in Vancouver's Island, Washington, Oregon, Nevada, Montana, Utah and Idaho.

Remarks:—Very much like ochracea, but it is distinguished from others by the absence of ocelli on both wings, above and below. According to Edwards ampelos and elko are same. He has found two specimens with spots on the secondaries.

THE PLAIN RINGLET, Coenonymph tiphon, var. laidon, Borkh.

Butterfly—This butterfly was described by Edwards as **C. inornata** Dr. Buckell called attention to its resemblance to the European form. His view is confirmed by Dr. Skinner in his recent paper previously referred to. The following is Edwards' description of **inornata,** and therefore of **laidon.**

Male—Expanse, 1.40 inch, 35 mm. Upper side ochrey-brown, lighter in the disk of all wings; costal margin of primaries and abdominal margins of secondaries grayish, no spots above or below; fringe gray, crossed by darker lines. Under side: primaries same color as above, from base to beyond the middle, then a transverse sinuous ray of paler color, and beyond this to hind margin grayish; sometimes this ray disappears, the basal color extending nearly to the apex; secondaries gray, with a slight grayish tinge, darker from base to middle, and this shade separated from the paler margin by a transverse tortuous interrupted ray, the course of which is parallel to the hind margin.

Female—Wholly dull ochrey-yellow, marked as in the male.

Dr. Skinner adds: "This species is readily distinguished by its rich dark color, being the darkest of all the species except **haydeni**. Like all the other species it has ocelli. Mr. Edwards' specimens were evidently devoid of ocelli, as he says 'No spots above or below.' "

Distribution—The species occurs in Montana, Minnesota, British America and Newfoundland. Examinations show the collections to have one from Mount Lo Lo by Elrod and one from Miles City by Wiley. Collected by Coues in the mountains along the northern border in 1874.

HAYDEN'S RINGLET, Coenonympha haydeni, Edwards. Fig 92.

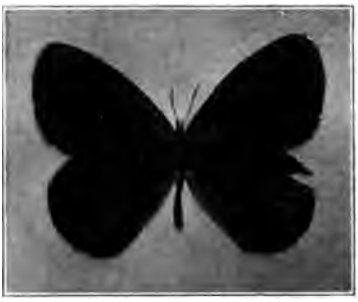


Fig. 92. **Coenonympha haydeni.**

Butterfly, Male—Upper side entirely of a bright glossy ochre-yellow, without any spot or mark, except what is caused by the transparency of the wings; base of both wings dark grey; abdominal margin of secondaries pale gray; fringe pale gray, crossed by a darker line. Under side. Primaries same color as above; costal margin, apex and base grayish; near the apex a round, sometimes a rounded-oblong, black spot with white pupil and pale yellow iris; this is preceded by an abbreviated, pale yellow, transverse ray. Secondaries light reddish brown, grayish along

Butterfly, Male—Expanse, 1.60 inches, 40 mm. Upper side fuscous, immaculate; under side a shade paler, much irrorated with gray scales; primaries immaculate; secondaries have a complete series of black ocelli along the hind margin, one in each interspace; each ocellus narrowly ringed with ochraceous, and having a minute white pupil.

The female is like the male in markings, but in color quite different, as it is light yellowish-brown.

Distribution—The species has been found in Montana, Idaho, Colorado and Wyoming. The University of Montana has but one specimen at present writing, collected by Douglas in the Tobacco Root range. Cooley has taken it at Mystic lake, 6,700 feet elevation, in Bridger canyon, along Shield's River, at East Flathead in Park county, and at Bozeman.

List of Butterflies taken by H. R. Morrison in Dakota and Montana, 1881.

1. **Papilio zolicaon, Bois.**
2. **Pontia (Pieris) protodice, Bois.**
3. **Eurymus (Colias) philodice, Godart.**
4. **Eurymus (Colias) eurytheme, form keewaydin, Edw.**
5. **Argynnis cybele, Fab.**
6. **Argynnis aphrodite, Fab.**
7. **Argynnis nevadensis, Edw.**
8. **Argynnis Edwardsii, Reak.**
9. **Brenthis (Argynnis) myrina, Cram**
10. **Euptoieta claudia, Cram.**
11. **Lemonias (Melitea) acastus, Edw.**
12. **Phyciodes carlota, Reak.**
13. **Phyciodes tharos, Drury.**
14. **Basilarchia (Limenitis) wiedemeyerii, Edw.**
15. **Pasilarchia (Limenitis) disippus, Godt.**
16. **Coenonympha tiphon, var. laidon Bork (inornata Edw.)**
17. **Cercyonis (Satyrus) alope, var. nephele, Kirby. (nephele, var. olympus, Edw.)**
18. **Cercyonis (Satyrus) meadii, Edw.**
19. **Cercyonis (Satyrus) sylvestris, var. Charon, Edw, (charon).**
20. **Cercyonis (Satyrus) sylvestris, Edw.**
21. **Oeneas (Chionobas) varuna, Edw.**
22. **Uranotes (Thecla) melinus (humuli).**
23. **Thecla liparops, Bois & Le Conte, (strigosa, Harr).**
24. **Thecla acadica, Edw.**
25. **Mitoura (Thecla) damon, Cramer, (smilacis, Bois).**
26. **Gaeides (Chrysophanus) dione, Scudder.**
27. **Epidemia (Chrysophanus) helloides, Bois.**
28. **Chalceria (Chrysophanus) rubidus, Edw.**
29. **Cupido (Lycaena) saepiolus, Bois.**
30. **Rusticus shasta Edw., (Lycaena lupini, Bois.)**
31. **Rusticus (Lycaena) melissa, Edw.**
32. **Rusticus (Lycaena) acmon, West.—Doub.**
33. **Cyaniris (Lycaena) ladon, Cramer (pseudargiolus, Bois.)**
34. **Cyaniris (Lycaena) ladon (pseudargiolus), form violacea, Edw.**
35. **Everes (Lycaena) comyntas, Godt.**
36. **Pholisora (Ancyloxypha) lena, Edw.**
37. **Oarisma (Thymelicus) poweschiek, Parker.**
38. **Erynnis (Pamphila) pawnee, Dodge.**
39. **Erynnis (Pamphila) uncas, Edw.**
40. **Limochroes (Pamphila) manataaqua, Scudder (cernes, Harris.)**
41. **Euphyes (Pamphila) vestries, Bois, var. metacomet, Harr. (metacomet, Harr.)**

42. Phycanassa (Pamphila) vitellus, Fab. (delaware, Edw.)
43. Ambliscirtes vialis, Edw.
44. Pyrgus montivaga, Reak. (tesselata, Scud.)
45. Scelothrix (Pprgus) scriptura, Bois.
46. Thanaos perseus, Scudder.

This list of 46 species is given by W. H. Edwards in the Canadian Entomologist, Vol. XIV, p. 6, 1882. As here given the nomenclature used in this work has been used. Where the names used by Edwards are different from those used in this book they follow immediately and without commas, in parentheses. Where parentheses do not occur the Edwards names and names used by us are the same.

From this list it is impossible to tell which specimens were collected in Montana and which in Dakota. The species which are not included in this work are Nos. 20, 25, 26, 41, 42, and 43. Whether these are to be included in the lost from Montana is yet to be determined.

Genus OENEAS HUEBNER.

The Arctics.

Butterfly—The antennae are short, the eyes of moderate size; The front full, protuberant; the palpi slender; the fore wing somewhat produced at the tip; with the outer margins rounded and the hind margins slightly, if at all, sinuated. The nervules of the fore wings are slightly dilated toward the base; the hind wings are elongated, oval, and the outer margins evenly rounded. The color of these butterflies is some shade of brown; the outer margin is generally lighter than the base of the wing, and is marked with black spots, sometimes pupiled with white. The wings are generally marbled and mottled on the under side, and sometimes crossed on the middle of the hind wings by a broad band of darker color. The fringes are brown, checkered with white. The eggs are ovate, spherical, marked with sculptured ridges. The caterpillars are pale green or brown, marked by darker stripes upon the back and on the sides. The chrysalids are stout, very slightly angulated, and are formed, so far as we know, unattached under stones and at the roots of grasses.

The genus contains insects belonging to the Arctic fauna, which are formed in the far north or dwell upon the lofty mountain summits where the season is short. Of the large number of species formerly recognized but seven are retained, the others being placed as sub-species or varieties. At the present time but two are recorded from the state, although we should expect **nevadensis**, and possibly **macounii**.

Key to species.

Dark brown color, covering basal and median areas; a broad band of lighter shade on outer margin; under side mottled with white and brown. chryxus

Smaller, lighter in color; under side mottled with brown and black varuna

THE CHRYXUS BUTTERFLY. Oeneas chryxus, Westwood. Plate X. also Plate 1.

Butterfly—Expanse, 1.75 to 2.25 inches, 44 to 57 mm. Light brown above, usually with darker color on the basal and median areas of both fore and hind wings, leaving a broad band of lighter color. A narrow dark brown or brownish black outer margin on both pairs of wings. Outer edges fringed with dashes or crescents. Edge of costa usually mottled. Wings on under side beautifully mottled with white and dark brown, a heavier band of almost black crossing both wings near the center, making an acute angle toward outer edge near the middle of fore wing. One to several eye spots, some pupiled with white, which show above as dark brown or black. The plate shows some of the variations of the species.

Distribution—The insect is found over a wide territory, from Hudson Bay and British Columbia to Colorado, the light colored variety invalida in Nevada and California. It has been taken in the state by Cooley in Gallatin county at 9,400 feet, and at Missoula; by Brandegee at Rimini near Helena and at Cascade on the Missouri river; Douglas collected it in the Tobacco Root range; Elrod has specimens from Missoula, from Mount Lo Lo, from Geyser Basin in the Yellowstone Park, and from the Swan range. The species is alpine. It has not been taken below 5,000 feet at Missoula, and above this is quite common. It has frequently been seen in the Swan range above 6,000 feet.

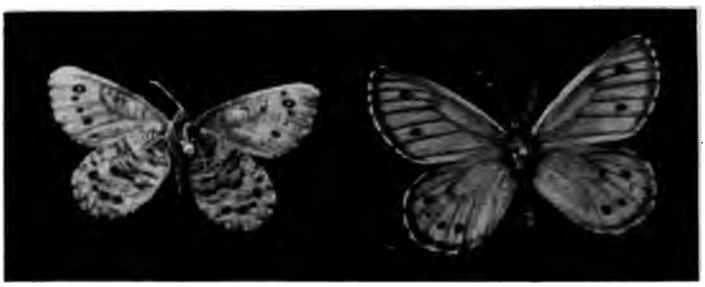
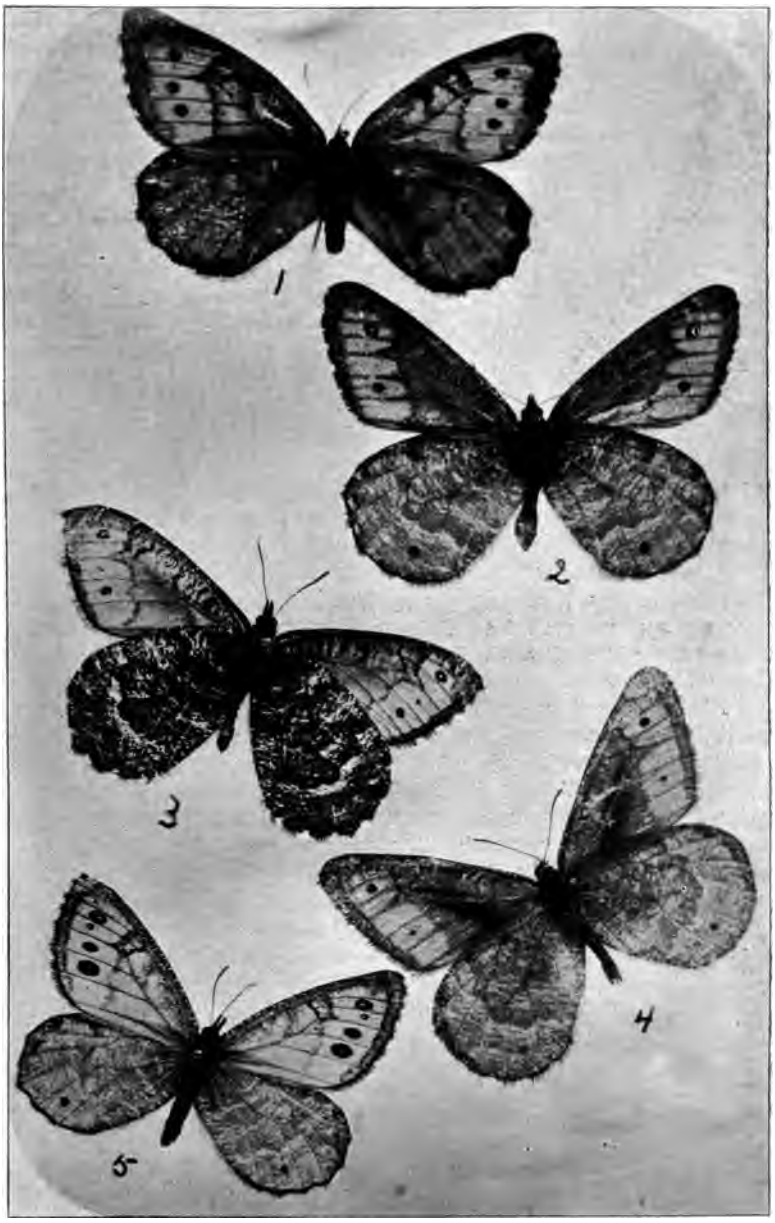


Fig. 92A. **Oeneas uhleri**, var. **varuna**; lower surface on left, upper surface on right; natural size.

THE VARUNA ARCTIC. Oeneas uhleri Reakirt, var. varuna, Edwards.

Butterfly—Expanse, 1.50 to 1.75 inches, 38 to 45 mm. The butterfly is among the smallest of the Oeneas group. It is light tan colored above, with a narrow dark grown border on both wings. Edges with light fringe, broken by the brown. On the under surface the wings are mottled with brown, strongly marked with blackish blotches or shades. Usually several (two to five) eye spots, black, mostly pupiled with white, which show through as black.

Early Stages—Fully described by Edwards in Volume III of his great work "The Butterflies of North America." Eggs chalk-white, conical, truncated, ribbed. Mature larva .90 to .94 inches long, stout, thickest at the middle, a lateral band and several stripes of black, the intervening bands solid green. Under side, feet and legs, green, with a tint of brown. Chrysalis about .50 inch long, greenish yellow, wing cases



Oenas chryxus, showing various forms of wing coloration. No. 3 is lower surface.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

a shade of brown, head and abdomen with still more brown. Larval
d, eleven to twenty days, pupal period about eleven days.

istribution—It is found in the prairie lands of North Dakota, and the
of Montana and Canada adjacent. It is not uncommon about Cal-
Wiley has collected many specimens around Miles City, and in
sent eggs to Edwards to be hatched. Cooley has collected it at
man. Taken by Coubeaux in Bear Paw Mountains.

Genus NEOMINOIS, Scudder.

RIDINGS SATYR, Neominois ridingsii, Edwards.

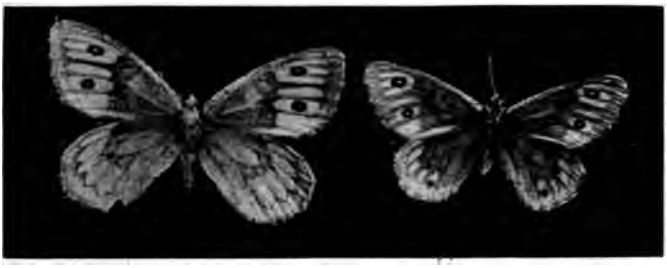


Fig. 92B. **Neominois ridingsii**, natural size.

utterfly—Expanse, Male, 1.6 to 1.8 inches, Female, 1.8 to 2 inches.
pper side dusky gray-brown, pale over the basal areas, beyond to
in dark; a common extra-discal series of buff spots, on primaries
ated in the lower discoidal interspace; the four above this con-
t, their outer extremities lanceolate, and being on the upper dis-
l interspace a white pupiled black ocellus; the fifth spot is long,
narrower than the interspace—the upper median; the sixth is sub-
broad, and carries a second ocellus, usually equal to, but sometimes
le smaller than the other; the next two spots are sometimes com-
y confluent, and are about half the length of the sixth; on second-
the spots from a continuous band of nearly even width, the upper
more or less incised on the basal side; the outer ends serrate, or
lanceolate; a small black patch near the outer edge of the spot
wer median interspace; occasionally a minute pupiled ocellus is
nt on the lower sub-costal interspace of primaries, outside the line
principal ocelli; fringes fuscous, yellowish at the tip of the ner-

nder side paler; the cell of primaries and the basal and marginal
of both wings covered with fine abbreviated dark streaks; the
and ocelli of primaries repeated; the buff band of secondaries rarely
y repeated, but the position of the outer edge of it is indicated
black serrated line; the marginal inscriptions usually extend across
ine well toward the mesial band; this band is closely as in the
genus Oeneas, light within ,dark near and along both edges; the
without rectangular on the lower discoidal interspace, with equal
ions from the angle to costa (though sometimes the lower two are
prolonged, acuminate); on the basal side a small angular sinus
sub-costal nervure, and a large rectangular, or sometimes rounded,
tion on the median.

Body dusky gray-brown; beneath light and concolored with the wings; femora light grey, the tibiae red-brown; palpi whitish, with many black frontal hairs; antennae fuscous above, cretaceous below; club red-brown beneath and at the tip.

The female is very much like the male; some individuals have a small ocellus on the upper median interspace.

A late form is a little larger, than the other, paler colored, especially beneath, where the inscriptions are faint and the space which on the upper side is occupied by the buff band is scarcely outlined; the mesial band but a shade darker than the basal area.

The above lengthy description is taken from Edwards. The species was reported after the manuscript for this work was completed and the cuts made.

Early Stages—The egg is sub-conic, base and top flattened, marked by nineteen and twenty vertical ribs; color chalk-white. The mature larva is about an inch in length, covered thickly with small pointed tubercles of irregular sizes, each bearing a rather long, clubbed and appressed whitish process; color reddish buff, the sides pale green; mid-dorsal stripe pale black; feet and legs gray-green. The chrysalis is about a half inch in length, cylindrical; color red-brown, darkest anteriorly, the divisions of the abdomen green; wing cases green, around the margin brown. Pupation takes place under the ground.

Distribution—It is reported from the Mountain states of the Pacific coast. In Montana it has been collected by Cooley at Bozeman and by Coubeaux at Big Sandy.

EXCHANGES.

One of the best ways of adding to a collection is by the method known as exchanging. A collector in one part of the country may find species which are rare, or altogether unknown, in another part of the country. By a system of exchanges with other collectors he is able to supply the gaps which may exist in his collection. No one, however, cares to effect exchanges with collectors who are carless or slovenly in the preparation of their specimens, or inaccurate in naming them. A collector who contemplates making an exchange should, as the first step, prepare double lists, in one of which he gives the names and the number of specimens of either sex of the butterflies which he is able to offer in exchange; in the other he sets forth the things which he desires to obtain. The first list is said to be a list of "offerta"; the second is a list of "desiderata." As an illustration of the manner in which such lists may be conveniently arranged, I give the following:

Offerta.

Papilio turnus—Male three; female four. **Dimorphic** var. **glaucus,** male six. **Colias alexandra,** male four; female six.

Desiderata.

Papilio nitra, female.

Papilio brevicauda, orange-spotted var.

The collector who receives these lists of offerta and disiderata will be able to decide what his correspondent has which he desires, and what there may be in his own collection which the correspondent wishes that he can offer in exchange ;and the process of exchange is thus immediately facilitated.

Persons who exchange insects with others should always be extremely careful as to the manner of packing the specimens. Too much care cannot be taken in preventing damage to specimens in transit.

Holland, in "The Butterfly Book."

Family LYCAENIDAE.

The Gossamar-winged Butterflies, the Blues and Coppers. Fig. 93.

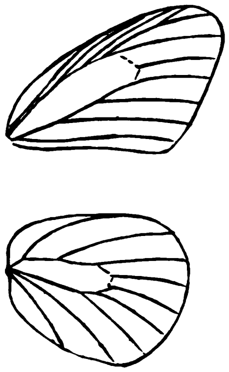


Fig. 93. **Venation of Rusticus melissa.**

The family includes butterflies of small size and delicate structure. They are easily distinguished from the skippers. The body is slender, the wings delicate and often brigntly colored, and the club of the antennae straight. The antennae are nearly always ringed with white, and a conspicuous rim of white scales encircles the eyes. The radius of the fore wings is three or four branched.

The blues can be distinguished from the metal-marks by the absence of the costal and humeral veins of the hind wings.

In the female the front legs are like the other legs, in the male they are shorter, without tarsal claws, and with the tarsi more or less aborted.

The caterpillars are slug-like. The body is short and broad, the legs and prolegs are short and small, allowing the body to be closely pressed to the object upon which the insect is moving—in fact some of the species glide rather than creep. Some of the species are remarkable for having honey-tubes which can be pushed out from the seventh and eighth abdominal segments, and through which honey-dew is excreted for the use of ants.

The chrysalids are short, broad, ovate, without angulations. They are attached by the candal end, by a loop passing over the body near its middle.

There are three well marked groups, which have been distinguished as the hair-streaks, the coppers, and the blues.

Key to Species.

1. Radius of the front wings four branched, wings blue or copper color 7.
Radius of the fore wings only three branched, under side of wings with hair like streaks 2.
2. Hind wings with a long, slender, tail-like prolongation 3.
Hind wings with only a short projection if any 6.

Upper surface of wings conspicuously marked with blue scales
Upper surface of wings with but few if any blue scales 4.
Lower surface of hind wings bright green marked with brown and white Mitoura P.
Lower surface of hind wings not green 5.
Lower surface of wings with a narrow white-edged bar at end of discal cell Thecla, P. 127
Without bar at end of discal cell Uranotus, P. 126
Under side of hind wings without a row of orange spots Incisalia, P. 130
Under side of hind wings with a row of orange spots Stryman, P. 131
Under side of hind wings pale fawn, with a row of red spots Erora, P. 131
Under side of hind wings green Callophrys, P. 130
Color above orange red with a coppery luster, or brown with a coppery tinge, in each case spotted with black 8.
Color above blue or bluish black 10.
Hind wings with a broad orange-red band on the outer margin extending from the anal angle nearly to the apex 9.
Hind wings with a sinuous submarginal orange line beginning at the anal angle and fading out near the middle of the outer margin Epidemia, P. 133
9. Fore wings fulvous, hind wings brown Heodes, P. 134
Both wings brown Gaeides, P. 133
Wings under side front wings orange hind wings gray Chalceria, P. 134
Wings under side front wings orange hind wings gray Chrysophanus
0. Hind wings with a slender tail like prolongation Everes, P. 139
Hind wings without tails 11.
1. Under side fore and hind wings similar 13.
2. Under side of secondaries pale gray with white spots Agriades, P. 136
Under side gray, with spots pupiled with black Cupido, P. 135
13. Hind wings with golden or orange spots Rusticus, P. 137
Hind wings without golden or orange spots 14.
4. Lower surface of wings slate brown Nomiades, P. 136
Lower surface of wings pale ash gray Cyaniris, P. 138

THE GRAY HAIR-STREAK or MELINUS BUTTERFLY, Uranotes melinus Figs. 94, 1, and 2.

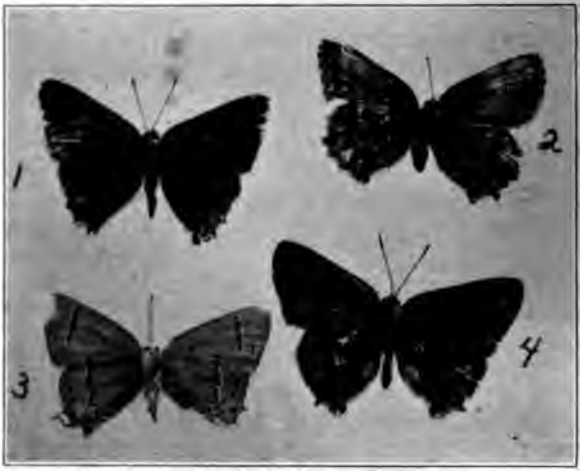


Fig. 94. **Uranotes melinus**; 1, upper; 2, lower side; 3, **Incisalia eryphon**; 4, **Thecla saepium.**

Butterfly—Expanse, 1.10 to 1.20 inches, 28 to 30 mm. This butterfly is easily recognized by its slaty upper surface, adorned by a large black spot, crowned with crimson, between tne origin of the two tails of the secondaries. Along the outer margin is a series of more or less distinct pale blue spots. An orange spot at the anal angle: Two slender tails. Under side gray, two black lines crossing both wings, the inner on the hind wings forming a W. The other spots repeated on the under side.

Early Stages—The larvae are "green, downy caterpillars," feeding on the common hop vine.

Distribution—Found all over temperate North America, ranging southward into Mexico, at suitable elevations. It has not been found abundantly in the state. Three specimens have been taken at Missoula. It has been taken at the University of Montana Biological Station at Flathead lake, but is not plentiful. Wiley has one specimen from Miles City.

Fig. 95. **Lycaena** on the banks of Sinyaleamin Lake, Mission Mountains, Mountains.

Genus THECLA. Fig. 96.
Key to Species.

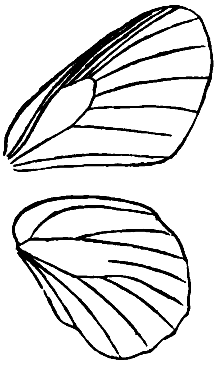


Fig. 96. **Venation of Thecla.**

Lower surface of wings with a narrow white-edged bar at the end of the discal cell	acadica
Lower surface of wings crossed just outside of the middle by a row of small, dark, blue-edged spots, which form an almost continuous line	calanus
The spots of the extra mesial row of the lower surface of the wings wide and discontinuous	liparops
Lines of spots on the lawer surface narrowly defined externally by white	saepium

THE HEDGE-ROW HAIR-STREAK, Thecla saepium Boisduval, Fig. 94.

Butterfly—Exanse, 1.20 inches, 30 mm.

Upper side quite uniformly reddish brown, paler on the under side; a narrow submarginal and an irregular median transverse band, narrowly defined externally by white; a well defined black spot at the anal angle of the secondaries.

Early Stages—Unknown.

Distribution—Found throughout the Pacific states, in Montana and Colorado. Holland thinks it identical with **chalcis.** Taken in the state at Missoula (4).

THE STREAKED HAIR-STREAK, or LIPOROPS BUTTERFLY.

Thecla liparops, Boisduval and LeConte.

Butterfly—Dark brown on upper side, grayish below. The lines on the underside are arranged in pairs, and very narrow. The spots at the anal angle are obscure and blackish. Expanse, 1.15 inches, 29 mm.

Early Stages—Almost entirely unknown.

Food—The caterpillar feeds on a variety of plants, oaks, willows, the wild plum and the Ericaceae.

Distribution—It ranges through the northern Atlantic States and Quebec to Colorado and Montana, but it is nowhere common. We have not taken it.

THE BANDED HAIR-STREAKED, Thecla calanus. Hubner.

Butterfly—Expanse, 1.2 inches, 30 mm.

The upper surface of the wings is dark brown or blackish brown There is sometimes an orange spot at the anal angle. The under side is blackish slate brown, nearly' as dark as the upper surface; there is a dark bar edged with bluish white at the end of the discal cell of both wings, and just outside of the middle a row of small, dark, blue-edged spots, which form an almost continuous line; and a submarginal series of crescents, edged within with white.

Early Stages—The caterpillar is 1.5 inches in length, slug-shaped, bright grass green or purple brown in color, marked with lighter and darker lines running lengthwise of the body. The food plants are oak, hickory and butternut.

Distribution—East of the Rocky Mountains.

THE ACADIAN HAIR-STREAK, Thecla acadica, Edwards. Plate I.

Butterfly—Expanse, 1.5 inches, 38 mm. The upper surface of the wings is of a uniform blackish slate brown; costal edge of fore wings, especially near the base, tawny. Anal angle of the hind wings with a submarginal, orange, lunate spot, which is indistinctly continued to the inner border of the wing. The under surface is pearl gray; on each wing at the end of the discal cell there is a dark bar edged with white; beyond this a bent row of roundish black spots encircled with white; and beyond this a submarginal row of black lunules edged within with white, and followed without by orange spots. The orange spots of the front wings are inconspicuous; but on the hind wings they increase in sizze toward the anal angle, except that one is largely covered by a blue patch.

Early Stages—Caterpillar; Length about one-half inch; slug-shaped; the brown head is very small; the body is almost oval in outline and grass green in color. Two yellowish stripes along the side include a row of oblique short stripes of the same color. The food plant is the willow.

Distribution—From New England west to Montana and Vancouver. South to Los Angeles. Taken in Nevada and Arizona. In Montana taken occasionally at Flathead lake. It is scarce.

Genus INCISALIA, the Elfins.

Butterfly—The hind wings have only a short projection, if any, at the anal angle. The under side of hind wings without a row of orange spots. Dark brownish butterflies, with the fringe of the hind wings a scalloped outline. No prominent tail like prolongations of the wings. In the outer third of the inner margin of the hind wings there is a deep rounded excision, producing a conspicuous lobe at the anal angle. Discal spot present in the fore wings of the males, usually inconspicuous. Under surface almost as dark as the upper, especially on the basal half, which is separated from the outer half by a wavy line.

Key to Species.

A large rusty brown space in the middle of each wing of the female, but near the anal angle of the male	niphon
The inner of the two dark bands on the outer third of the wing not sharply angulated below the third median nervule	eryphon
Outer half of the lower surface of the hind wings uniform rust red	augustus
Outer half of lower surface of hind wings sprinkled with pale lilac	irus

THE HOARY ELFIN, Incisalia irus Godart. Fig. 97.

Butterfly—Expanse, 1.10 inches, 23 mm. Grayish brown on the upper side; wings below are of the same color, paler on ahe outer margins, and darker toward the base; the outer half of the lower surface of the hind wings sprinkled, especially near the margin, with pale lilac scales, giving it a hoary bloom.

Early Stages—The caterpillar is said to feed on the plum.

Distribution—The species is rather rare, but has been found from the Atlantic to the Pacific in latitude of New England. In the state it has been taken on Mount Ascension, near Helena (one), by Brandegee; at Winscott (one), 6,000 feet (near Helena), by Brandegee; at Miles City (one) by Wiley.

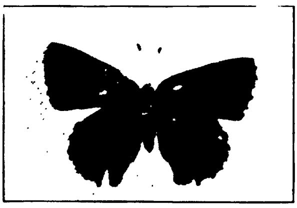


Fig. 97. **Incisala irus.**

THE BANDED ELFIN, Incisalia niphon Huebner.

Butterfly—Expanse, 1. 10 inches, 28 mm. Upper side dark blackish brown, a large rusty brown space in the middle of each wing of the female, but only near the anal angle of the male; a distinct white or whitish edging near the base of the under side of the hind wings, limiting a darker band that occupies the outer two-thirds of the basal half of the wing; males with a small, oval, sub-costal sex mark. The under side is light brown, sprinkled with white scales so as to be hoary. Fore wings with a brown bar at the end of the cell, edged outside with white; a brown spot farther toward the base. Beyond the cell a somewhat zigzag white line, beyond this a submarginal row of dark brown lunate spots. There are no tails, but three prominent teeth or angles to each hind wing. There are white fringes to both wings.

Early Stages—The larva is green and pubescent, longitudinal stripes on the back, the middle one pale yellow, the other two white. The head is brown. The chrysalis is grayish, with four rows of small spots, of which the two middle are black, the others ferruginous. The food plant is the pine.

Distribution—From the Atlantic westward to the Rocky Mountains. In Montana it has been taken at Miles City by Wiley, and at Bozeman by Cooley. So far as we know at present it has not been taken west of Bozeman.

THE ERYPHON HAIR-STREAK, Incisalia eryphon Boisduval. Fig. 94.

Butterfly—Closely resembles **niphon**, both on the upper and under side of the wings, but easily distinguished by the fact that on the under side of the fore wings the inner of the two dark bands on the outer third of the wing is not sharply angulatel below the third median nervule, and is in general parallel with the sub-marginal line.

Early Stages—These have not been described.

Distribution—A Pacific coast species that has travelled across the mountains eastward as far as Miles City, Montana, where it has been collected by Wiley. Cooley has collected it at Bozeman and Brandegee at Mount Ascension near Helena, east of the range. We have collected it Missoula and at Lo Lo Hot Springs.

THE BROWN ELFIN or AUGUSTUS BUTTERFLY, Incisalia augustus Kirby.

Butterfly—Expanse, .90 inch, 23 mm. Brown on the upper side, paler on the under side. The fore wings are marked below by a straight incomplete median band, and the hind winks by an irregular curved median band or line. Back of these lines toward the base both wings are darker brown. The outer half of the lower surface of the hind wings a pretty uniform rust red, darkest near the margin.

Early Stages—The caterpillar is "carmine red," covered with very short hair, each segment involute above, with double foveae. The chrysalis is pitchy brown, covered with very short bristly hair, the wing cases paler. Holland says the food plant is unknown. Fiske thinks from actions the food plant is the blueberry.

Distribution—The species is found in New England and northward and westward into the British Possessions. It is a boreal species. Elrod has taken it at Missoula, Cooley at Bozeman at 5.400 feet, May 31. 1900.

Genus CALLOPHRYS, Billberg.

THE GREEN WHITE-SPOTTER HAIR-STREAK, Callophrys dumetorum Boisduval.

Butterfly—Expanse, 1.10 inches, 27 mm. Dark fawn-color above, sometimes tinged externally with reddish. On the under side both wings are green, the primaries having a short straight band of white spots on the outer third, and the secondaries a small white spot on the costa beyond the middle, and two or three conspicuous white spots near the anal angle.

Early Stages—We know practically nothing of these.

Distribution—The Rocky Mountains and California.

Genus ERORA Scudder.

THE EARLY HAIR-STREAK, Erora laeta. Edwards.

Butterfly—Expanse, .75 inch. The wings are brown, glossed with bright blue above; on the under side pale fawn. with a band of pale red spots on both wings about the middle, and a few similar spots on the outer and inner margins of the hind wings.

Early Stages—Unknown, save that the egg has been described by Scudder.

Distribution—Dyar gives it as Montana and Colorado. Holland says it has been taken in Arizona. It is rare in collections. We have not taken it.

Genus STRYMON.6Hubner.

THE CORAL HAIR-STREAK, Strymon titus Fabricius.

Butterfly—Expanse, 1.30 inches. 32 mm. Upper surface dark brown, with or without an outer marginal row of orange spots or an indistinct orange band; males with discal stigma. Under surface soft slaty brown, sometimes tinged with violaceous; outer half of wings crossed by a series of black spots, encircled or bordered without with white; between these spots and outer margin is a series of small black lunules, bordered within with white and followed without by a corresponding series of coral red or orange spots, indistinct or wanting on the fore wings, prominent on the hind wings.

Early Stages—The caterpillar when full grown is sevent-enths of an inch long, elliptical in shape, heavy, very small, bilobed, and shining, with a streak of dull white across the front above the mandibles. Body above dull green, with a yellowish tint especially on the anterior joints, and thickly covered with very short brown hairs. A dark green dorsal line from joint two to four; a patch of dull pink on anterior joints. On the posterior joints is a much larger rosy patch, extending from the posterior of joint nine to the end of the body. Posterior part of the body suddenly flattened, side acutely sloped. The chrysalis is .45 inch long, glossy pale brown, with many small dark brown dots, and thickly covered with very short brown hairs, too fine to be seen without a lens. The larva feeds on the wild cherry and plum.

Distribution—It occurs from the Atlantic to the Pacific, from Maine to Georgia. At the present time a single specimen has been taken iln the state, at Missoula. It is therefore quite rare. Coubeaux has a specimen collected at Big Sandy. Coues collected a single specimen in 1874 among the mountains of our northern border, called by Edwards **Thecla mopsus.**

Genus GAEIDES, Scudder.

EDITH'S COPPER, Goeides editha Mead. Fig. 98.

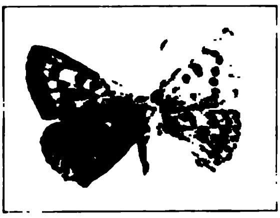


Fig. 98. **Gaides editha.**

Butterfly—Expanse, 1.25 to 1.35 inches (31 to 34 mm.) Male fuscous above, narrowly edged with black along the outer margin, and with black discal bar; the usual spots show through very faintly on the upper side. Hind wings fuscous, with similar black edge, and within this a row of four or five black spots near the anal angle. The two nearest this angle are surrounded by an irregular ochraceous line. Under side of fore wings gray inclining to fuscous, cinereous on the disc, with the black spots as allied species. Hind wings below gray-fuscous clouded with white. A rather broad band of gray-fuscous occupies the outer margin; this band is crenated inwardly and cut by a fulvous line which begins on the abdominal margin, extends out on the submedian and last branch of median nervules, thus leaving a white, black pupiled half.ocellus at anal angle, a large gray-fuscous crescent in the next interspace, and next to this a white, black-pupiled ocellus; in this respect the present species resembles Xanthoides and differs from Dione, which has much more fulvous. At the inner edge of the gray-fuscous band the white clouding is condensed into a continuous line of broad lunules, and at the inner border of this is the row of spots always fouund in this genus; these spots are quite large, pale gray-fuscous, edged with black and surrounded by white; the discal bar is usually confluent with the dot within the cell, so as to form an irregular horse-shoe mark.

Fringes of all the wings composed of scales of two lengths, the upper and shorter set being nearly black, the lower ones white; sometimes the black scales are a little longer in certain places, thus making the fringe seem white cut with black.

The last branch of median nervule of hind wings prolonged into a very slight tooth; this is more distinct in the female ,being there about as in **Xanthoides,** male.

The female differs from the male in always having at least a small fulvous or ochraceous cloud upon the disc of fore wing, and a similarly colored streak at the outer angle. The cloud upon the disc is sometimes so extended as to cover half the surface of the wing. The spots of lower surface are rather distinctly shown above. In the middle of secondaries there is often an ioration of fulvous scales and a distinct scalloped fulvous line along the outer màrgin, enclosing a black crescent, or double dot near anal angle and smaller dots above.

Under side like the male, but brighter, and with markings more distinct; a fulvous tint is also seen at outer angle of primaries.

This pretty little species may be distinguished from Xanthoides, its nearest ally, by its smaller size, the much more convex outer margins and more rounded outer angle of primaries, the blunter tooth of secondaries, the white clouding below and the large size of all the spots. (The above is a copy of the original description.)

Early Stages—Unknown.

Distribution—The species is recorded from Montana and Nevada. In the state it has been taken at Bozeman (2) by Cooley, and in the Swan Range, at 7,000 feet, near the Biological Station.

THE GREAT COPPER, Gaides xanthoides, Boisduval.

Butterfly—Expanse, 1.50 to 1.60 inches.

The species is easily recognized by its size, which is the largest of the group in North America, and by its creamy-white under surface, spotted with distinct small black spots, in large part reproducing the spots of the upper side.

Distribution—The species is reported from California and Montana. In the state it has been taken by Brandegee at Helena (1), and by Wiley at Miles City (2).

Genus EPIDEMIA Scudder. Fig. 99.

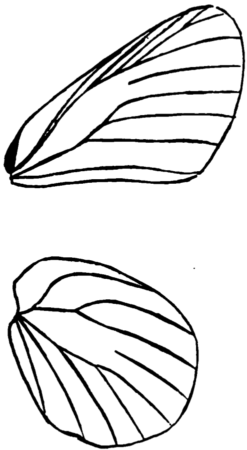


Fig. 99. **Venation of Epidemia.**

THE PURPLISH COPPER, Epidemia hellioides Boisduval. Fig. 100.

Butterfly—The male has the fore wings broadly shot with irridescent purple. The female has the fore wings of fulvous, with a broad black border. On the under side, the fore wings are pale fulvous, the hind wings a tan color, with a marginal row of brick red crescents. The usual black spots are found on both wings. Expanse, 1.15 to 1.30 inches, 29 to 32 mm.

Early Stages—These are practically unknown.

Distribution—The University of Montana collection has over a hundred specimens taken at Missoula, Flathead Indian Reservation, and University of Montana Biological Station by Elrod, by Douglas at Fish Creek in Sweet Grass County. It was abundant at the Biological Station at Bigfork in 1903, and in August, 1904. Cooley has many specimens from Bozeman, and Wiley collected many at Miles City. Brandegee has it in his collection from Helena. It has been taken by Coubeaux in the Little Belt and Bear Paw Mountains.

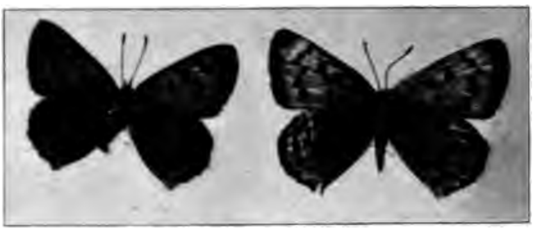


Fig. 100. **Epidemia helloides**, left figure male, right, female.

REAKIRT'S COPPER, Epidemia mariposa Reakirt.

Butterfly—Small, with a broad dusky band on the wind wing of the male, and on the fore wing of the female. The male is purplish red above, the female bright red with the usual spots. On the under side the fore wings are pale red, the hind wings clear ashen grey, with the markings. Expanse, 1.10 inches, 28 mm.

Early Stages—Undescribed.

Distribution—The species ranges from British Columbia into northern California, Montana and Colorado. We have taken it in the Yellowstone National Park.

Genus HEODES, Dalman.

The Coppers.

THE AMERICAN COPPER, Heodes hypophleas Boisduval.

Butterfly—Expanse, 1 inch, 25 mm. Upper surface of fore wings shining fulvous with a blackish brown border, narrow on the costa and hind margin. Beyond the cell is a row of prominent black spots. Hind wings blackish brown, and a terminal fulvous band, not reaching the apex, containing four black spots on the edge; at the end of the cell a black bar. Under side of fore wings fulvous, paler than above; the apex and whole of hind wings grey.

Early Stages—Eggs nearly round, a little flattended at the apex. They are pale green overlaid with a white network. The larva is elliptical, dull rosy-red, with a yellowish tint on the under side. The body is downy. The chrysalis is attached by the end of the abdomen.

Distribution—Found in northern, middle, and western states. Not rare at Miles City (Wiley). We have not taken it.

Genus CHALCERIA Scudder.

Key to Species.

Under side of fore wings same color as upper, spots repeated	**snowi**
Under side shining white	**rubidus**

SNOW'S COPPER, chalceria snowi, Edwards. Fig. 101.

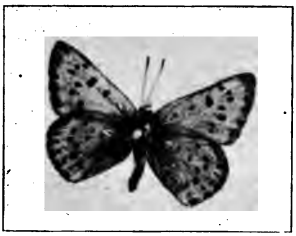


Fig. 101. **Chalceria snowi.**

Butterfly—Expanse, 1.15 to 1.25 inches, 28 to 31 mm. A medium-sized species, easily recognized by the even, rather black border on both wings on the upper side, and the dirty-gray color of the hind wings on the under side. The color above is red, brighter than **rubidus,** black border to both wings, dark at base. A row of black spots across each wing about one-third the distance from the apex to the base. Two black spots in the discal cell of the front wing, a larger spot at the outer end of the cell.

Under side of fore wing same color as upper, the spots repeated. Antennae black, tipped with reddish fulvous; palpi, legs and body clothed with white hair.

Early Stages—Unknown.

Distribution—It is found in Colorado at high elevations, and is reported from Alberta and British Columbia. Only one specimen in the collections examined, taken by Cooley in Gallatin county, July 12, 1902, at 9,400 feet.

Remarks—The species is named in honor of Chancellor Snow, of the Universitiy of Kansas and occurs at high elevations. It is a beautiful and delicate little creature, worthy of the effort necessary to capture it.

THE RUDDY COPPER, Chalceria rubidus, Behr. Plate I.

Butterfly—Rather large species; the male on the upperside is pale lustrous red, with a narrow black marginal band and uniformly conspicuous white fringes. The upperside of the female is a little lighter in the ground color; on the underside the wings are shining white, the secondaries immaculate. Expanse, 1.30-1.50 inches.

Early Stages—Unknown.

Distribution—The species is found in Oregon, Nevada and Montana. Wiley records it as rare at Miles City. Brandegee has one specimen from Gold Creek and Cooley one from Bozeman. Coubeaux has one specimen taken at Livingston. Dr. Elliott Coues took a single specimen near Three Buttes, August 8, 1874. Edwards says Dr. Hayden sent him occasional specimens from Montana. It seems to be everywhere rare.

Genus CUPIDO, Schrank.

THE LYCAEA BLUE, Cupido lycaea, Edwards, Plate XI, 1 and 2.

Butterfly—Expanse, 1.25 to 1.40 in., 31 to 35 mm. The adult male is pale blue above, the margins pale dusky. The black marks do not show through. The female is dusky, the wings shot with blue at their bases.

On the underside the wings are whitish. There is a row of black spots on the fore wings and a bar at the ends of the cell. The hind wing has also a row, but not so large.

Early Stages—These await description.

Distribution—The butterfly is found in the region of the Rocky Mountains, from New Mexico to Montana. The University of Montana collection has many specimens, collected as follows: at Madison Lakes by Douglas, at New Chicago by Fred D. Smith and Douglas, at Missoula by Elrod, and at Sinyaleamin Lake in the Mission Mountains by Elrod. At Sinyaleamin lake large flocks assembled about camp on the lake bank. Cooley has two from Bozeman, one from 5,800 feet altitude. Coubeaux reports it rather common in the mountains near Big Sandy.

THE GREENISH BLUE, Cupido saepiolus, Boisduval. Plate XI.

Butterfly—The male on the upperside has the wings blue, shot in certain lights with brilliant green. The female on the same side is dusky, with greenish blue scales at the bases of the wings and often with reddish markings on the outer margin of the hinds wings. On the underside, the wings are gray or pale wood-brown with greenish blue at their base and a profusion of small spots margined with white. Expanse, .95-1.10 in.

Early Stages—These have not been studied.

Distribution—The species ranges from British Columbia to Colorado. In western Montana this is a very common species. On the mountain slopes by the University it abounds in early spring, collecting in considerable numbers by the damp places. Along the roadside in the mountain canyons it is a conspicuous figure. It is found throughout the Mission Mountains and around the Biological Station at Flathead lake.

Genus NOMIADES Hubner.

THE SILVERY BLUE, Nominades lygdamas Doubleday.

Butterfly—Expanse, .85 to 1.10 inches, 21 to 27 mm. Upper side of wings of male pale silvery blue, narrowly edged with black; the wings of the female above darker blue, dusky on the borders, with a dark spot at the end of the cell of the primaries. Under side of wings pale chocolate brown, with a submarignal band of black spots, margined with white, on both wings, as well as a spot at the end of the cells, and one or two on the costa of the secondaries.

Early Stages—These are unknown.

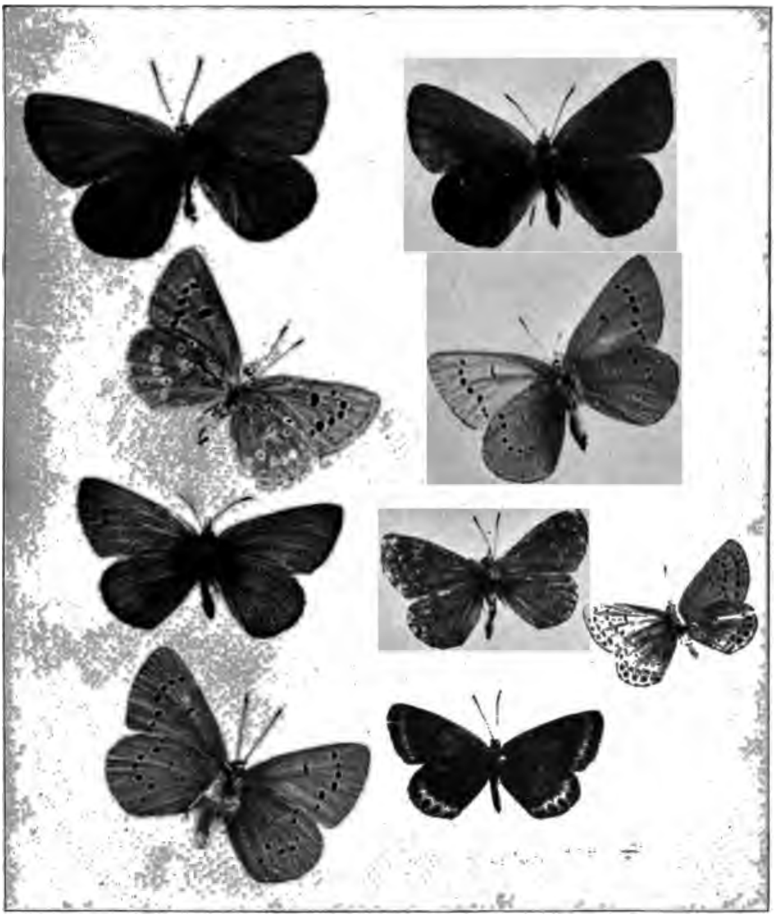
Distribution—Found in the South Atlantic states, Colorado, California, New Mexico, and in the Kootenai district of British Columbia. In the state collected by Brandegee at Helena, one male, and by Cooley at Bozeman, two males.

Genus AGRIADES Hubner.

THE RUSTIC BLUE, Agriades rustica, Edwards. Fig. 102B.

Butterfly—Expanse, .90 to 1.00 inches, 23 to 25 mm. Male bright blue above, female darker. Under side pale-gray on the secondaries, with white spots; primaries with a row of black spots, and a discal black spot bordered with white.

Early Stages—Unknown.



1, Cupido lycaea, male; 2, under side of same; 3, Cupido saepiolus male; 4, under side of same; 9, female of same; 8, under side of female of same; 7, Rusticus melissa, male, upper side; 6, under side of same; 5, upper side of female.

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ASTOR, LENOX AND
TILDEN FOUNDATIONS.

Distribution—Found in Colorado, Montana and British America. In e state taken at Bozeman by Cooley, one specimen, and at Bear Paw ountains by Coubeaux.

Genus RUSTICUS Hubner.

Key to Species.

range red or pinkish band on the hind wings	acmon
ark crescents of the under side showing as spots on the upper side	glaucon
ale with narrow black marginal line and white fringes	melissa
ale with wings colored dirty gray below, with black spots	shasta

THE ACMON BLUE, Rusticus acmon Doubleday and Hewiston.

Butterfly—Male blue; female brown. It may be distinguished by the oad orange-red or pinkish band on the hind wings, marked by small ack spots. On the underside it is marked much like L. melissa. Ex-anse, .90-1.10 in.

Early Stages—Unknown.

Distribution—It is found from Arizona to Washington and Montana.

The University of Montana collection contains two specimens from e Yellowstone National Park. Brandegee has it in his collection from elena.

THE COLORADO BLUE, Rusticus glaucon, Edwards.

Butterfly—Purplish blue, having the dark crescents of the underside owing as spots on the upper side. The female has a band of orange ots on the margins of the secondaries. Expanse 1.00 inch, 25 mm.

Early Stages—Unknown.

Distribution—It ranges from Washington to California and eastward Colorado, where it is juite common in the mountain valleys. The Uni-ersity of Montana collection contains 3 specimens; 1 from Missoula, and from Geyser Basin.

THE ORANGE-MARGINAL BLUE, Rusticus melissa, Edwards.
Plate XI, 5, 6 and 7, and Fig 102.

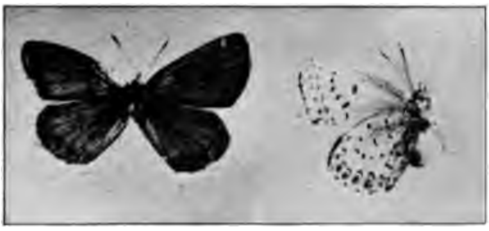


Fig. 102. **Rusticus melissa**, male, upper and lower surfaces.

Butterfly—The male on the upperside is pale blue, with a narrow ack marginal line and white fringes. The female is brown or lilac-ay, with a series of orange red crescents on the margins of both wings.

On the underside the wings are stone-gray, with the usual spots, and on the secondaries the orange colored marginal spots are oblong, tipped inwardly with black and outwardly by a series of metallic green maculations. Expanse, .90-1.15 in.

Early Stages—Very little known.

Distribution—It is found from Kansas to Arizona, and northward to Montana. The University of Montana collection contains specimens from the Mission Mountains, Flathead Indian Reservation, Missoula, New Chicago (Smith). It is reported as common at Miles City (Wiley). It is abundant around the University of Montana Biological Station at Flathead Lake. Taken by Couzeaux in the Bear Pow Mountains. Allen has it from Dillon. Coues collected a number of specimens from a number of localities along our northern border in 1874.

THE SHASTA BLUE, Rusticus shasta, Edwards.

Butterfly—The male is blue; the female brown. On the underside the wings are a dirty gray, with black spots, and in addition, on the hind wings, there are a number of small marginal spots, surmounted by metllic colored bluish green scales. Expanse, 1.00 inch.

Early Stages—These have not been described.

Distribution—It is found in Montana and Nevada. It is also reported from northern California and Oregon.

There are two specimens from Martinsdale in the University of Montana collection.

Genus CYANIRIS Dahlman.

THE COMMON BLUE or SPRING AZURE, Cyaniris ladon, Cramer.

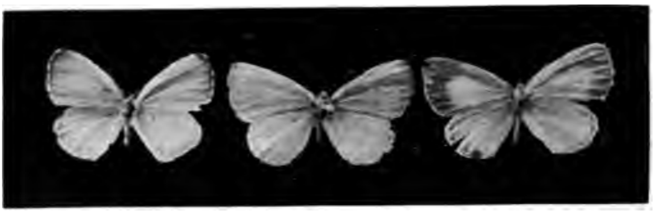


Fig. 102A. **Cyaniris ladon,** slightly reduced.

Butterfly—Expanse of wings, 9 inch to 1.4 inches, 23-25 mm. The species is subject to great variation. In general terms, the upper side of the wings of the male is a deep azure-blue with a delicate terminal black line. Fringes black on the apical part of the wings, but white barred with black on the rest of the fore wings and on the hind wings.

The fore wings of the female have a broad blackish outer border, in some examples extending along the costa. The hind wings have a blackish costa, and a row of dark spots along the outer margin. The ground color is usually a lighter blue on the females than on the males.

The under side is a very pale silvery gray, with a silky lustre, and there are the following pale brown markings: a row of spots along the outer margin, each preceded by a crescent; a curved row of alongate spots across the disk of the fore wings; and several small spots on the basal part of the hind wings.

The butterfly exhibits a very complicated polymorphism, both seasonal and sexual; nine forms are now recognized by entomologists. The form occurring in Montana is **C. ladon ladon.**

Early Stages—Length, two-fifths of an inch, slug shaped, dark brown head. Body white with a dusky line down the back and a greenish tinge along the sides.

Food—The larvae feed on dogwood, actinomeris, black snake-root, sumac, spiraea and many other plants.

Distribution—Its distribution is very wide, extending from Alaska south to Arizona, east to the Gulf of Mexico, and north to the St. Lawrence. Coubeaux reports it abundant around Big Sandy.

THE WESTERN TAILED BLUE, Everes amyntula Boisduval.

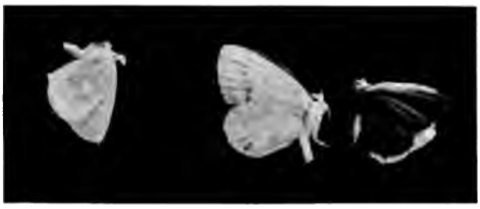


Fig. 102B. **Everes amyntula,** the two right hand figures, and **Agriades rustica,** left hand figure.

Butterfly—"Closely resembling **L. comyntas,** of which," says Holland, "It may be only a slightly modified western form. Until the test of breeding has been applied we cannot be sure of this."

Description of comyntas—Expanse of wings from .7 to 1 inch, 18 to 25 mm. Hind wings with one thread-like tail. The males are dark violet-blue above, with a narrow blackish outer border. Along the outer margin of the hind wings are several black spots, and usually one or two orange crescents. The female are blackish brown, some specimens with bluish at the base. The black spots of the hind wings are often obscure.

Underside whitish gray; both wings with a double row of spots along the outer margin, the inner row crescents; between this and the cells a fow of black spots circled with white, the row on the hind wings broken twice. There is also a bar at the end of each cell, and on the hind wings a spot in the cell, and one above. Near the anal angle are two or three orange crescents, enclosing each a black spot with a circle of silver scales.

Amyntula differs from the above as follows: The males are lighter blue above, the dark border much reduced. The black spots prevail, reduced, but the orange crescent has reduced to a black spot. The females are brownish black with a trace of coppery brown, the primaries with a large wash of blue over the posterior portion. The black spots are larger than in the male.

Early Stages—Unknown.

Distribution—It ranges from the eastern foothills of the Rocky Mountains to the Pacific in British America and the northern tier of western states. There are seven specimens in the University of Montaan collection from Sinyaleamin lake in the Mission Mountains. Coubeaux collected it in tne Bear Paw Mountains.

Butterfly Fancies.

Bits of fancy on the wing
In the sunbeam hovering,
Nimbly on the breezy air,
Can you be withount a care,
Thronging butterflies!

Once a caterpillar shroud,
Now in brightest winged crowd,
Life's intangible mysteries,
Unimprisoned fantasies,
Gauzy butterflies.

Better than the rival woods,
All of Nature's varied moods,—
Tints of dark and light, portraying
As with Nature's artist playing,
Dancing butterflies.

Whitness caught from mountain-crown,
Softest greys and sombre brown,
Brushed with dust of finest sift,
Streaked with blue, a storm-cloud rift,
Gleaming butterflies.

Vieing with the veering Wind
In thy wooing unconfined,
Near all flowers thy list'ning ear,
Trembling like a fluttering fear,
Vagrant butterflies.

Fanning blushes of the roses,
Ever changing are thy poses,
Couriers fleet of fairy news
Whisp'ring of the coming dews,
Cunning butterflies.

Skimming perfumed meadow lots,
Ye are Nature's sweetest tho'ts,
Fit to flit with soul of child,
Fairies fed with honey wild,
Golden Butterflies.

Hither, thither, in delight,
Circling round in rythmic flight,
If we had but keener ear,
Could we more of music hear,
Lyric butterflies?

Golden links in summer's chain,
Tell me all my heart would fain;
Give to me thy revelations,
Incarnate imaginations,
Fleeting butterflies.

Sleeping in a rose's breast,
By her paling petals prest,
Fainting as her heart throb's cease,
While the wails of winds increase,
Dying butterflies.

—ALBERTINE WARD.

ity of Montana, June 1, 1905.

THE SKIPPERS, SUPERFAMILY HESPERIINA.

Some authors consider the skippers to constitute a superfamily distinct from the butterflies. They are called skippers on account of their peculiar mode of flight. They are day-fliers, like butterflies, darting suddenly from place to place. When at rest most species hold the wings erect in a vertical position like butterflies; in some the fore wings are so held, the hind wings being extended horizontally. The antennae are thread-like, and enlarged toward the tip; but in most cases the extreme tip is pointed and recurved, forming a hook. The abdomen is usually stout, resembling that of a moth rather than that of a butterfly. Skippers are most easily distinguished by the peculiar venation of the fore wings, see Fig. 102, the radius being five-branched, and all the branches arising from the discal cell (R.—M. of Comstock).

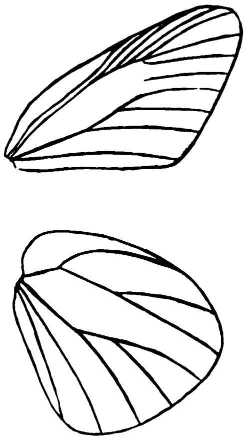
There are two families of skippers, the **Megathymidae** or **GIANT SKIPPERS**, and the **Hesperiidae** or **Common Skippers**. The former is not reported from the state, and hence not included in this list.

THE COMMON SKIPPERS. Family Hesperiidae. Fig. 102.

The figures following represent the family. The larvae have large heads and strongly constricted necks. They usually live concealed in a folded leaf or in a nest made of several leaves fastened together. The pupae are rounded, not angular, resembling those of moths more than those of butterflies. The pupa state is passed in a slight cocoon, which is generally composed of leaves fastened together with silk and thinly lined with the same substance.

Fig. 102. **Venation of Hesperiidae.**

Key to Subfamilies.



Antennae usually ending with a finely pointed terminal crook, occasionally
without crook and ending bluntly; males usually with a brand on
the fore wings, never with a costal fold. Skippers with a brand
and their allies Pamphilinae, P. 150

Antennae usually with a long club which is bent at a considerable distance from the tip; males almost invariably with a costal fold, never with a brand. Skippers with a costal fold and their allies Hesperiinae, P. 143

Subfamily Hesperiinae.

In this subfamily are included the larger of the common skippers, as well as some that are of smaller size. Most of the species are dark brown, marked with white or translucent, angular spots. The antennae usually have a long club, which is bent at a considerable distance from the tip. The venation is shown in Fig. 102. The most distinctive feature is exhibited by the males alone, but is lacking in some species. This consists in a fold in the fore wing near the costal margin, which forms a a long, slit-like pocket, containing a sort of silky down. This is a scent organ. Tubular scales, the **androconia**, open into it. This pocket is difficult to see when the pocket is closed.

Key to Genera.

1. Fore wings with a broad, bright yellow band near the middle 2.
Fore wings not crossed by a broad, bright yellow band 3.
2. With a large silvery-white spot in the center of the lower side of the hind wings Epargyreus, P. 143
3. Upper surface of wings black or brown, with a few white spots on the fore wings or with none, hind wings not checkered with white 4.
Both fore and hind wings checkered with many white spots 9.
4. Club of antennae hooked; anal angle of hind wings slightly prolonged Cocceius, P. 144
Club of antennae sickle-shaped; anal angle of hinds wings rounded 8.
Club of antennae thickened at the end, which is obtuse and bare 5.
5. No costal fold in the male Hesperopsis, P.
A costal fold in the male 6.
6. A pair of long lobes covering a bare hollow at base of addomen of male Scelothrix, P.
These lobes short or absent 7.
7. Hind tibiae with a hair pencil Heliopetes
Hind tibiae without a hair pencil Pyrgus, P.
8 Fore wings entire, with a costal fold in the male; costal fold short, less than half the margin Pholisora, P.
Costal fold of the male long; over half the margin 10.
9. The white spots in the band just beyond the middle of the fore wings much broader than high Pyrgus, P.
The white spots in the band just beyond the middle of the fore wings but little if any broader than high Scelothrix, P.
10. Third joint of palpi moderate, less than twice as long as wide Thanaos

Genus EPARGYREUS.

Key to Species.

1. Hind wings more or less produced or tailed at the anal angle 2.
Hind wings produced not tailed
2. Under side of hind wings with a silver band in the middle tityrus

THE SILVER-SPOTTED SKIPPER, Epargyreus tityrus, Fabricius. Fig. 103.

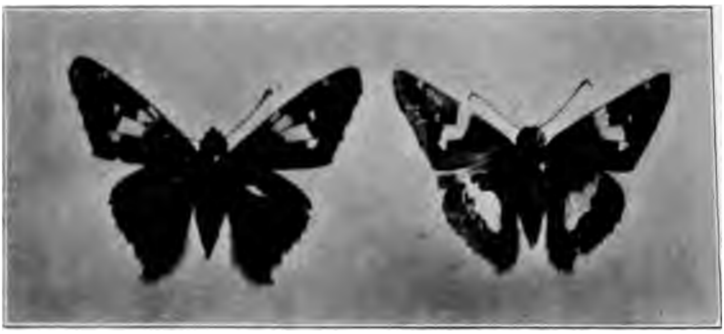


Fig. 103. **Epargyreus tityrus**, upper (left) and lower (right) surfaces.

Butterfly—Expanse, 1.75 to 2.00 inches, 43 to 50 mm. Upper surface dark brown. The fore wings are crossed by an oblique yellow band of four large, spots, from the middle of the costa to near the posterior angle, where it ends in a rounded spot. Beyond there is a narrow spot in the first median interspace extending from vein to vein. Fringes gray and brown at the edge of veins. Underside aboue the same, but this hind wings have a conspicuous silvery white band in the middle, nearly reaching the cosa; palpi brown, slightly yellowish beneath.

Early Stages—The egg is nearly globular, flattened at the base, with fifteen ridges from the base to apex. Color white, with a bright red spot at apex. The young larva is orange; head short, a few scattered over the body. It feeds upon the common locust, rose, acacia, wistaria, and a species of wild bean.

Distribution—It is found quite generally over the entire United States, more abundantly eastward. In Montana it has been taken by Wiley at Miles City, by Brandegee near Helena, and by Elrod at Flathead lake.

Genus COCCEIUS.

THE NORTHERN DUSKY-WING, Cocceius pylades, Scudder.

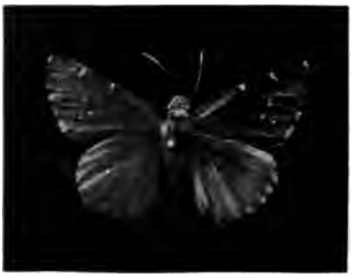


Fig. 103A. **Cocceius pylades**, slightly reduced.

Butterfly—Expanse, 1:60 inches, 40 mm. Brown above, darker at se of wings and anal angle; the white spots on the fore wings are mere ints, the number and size varying. On the under side the wings are rk brown, shading into hoary-gray on the outer margins. The hind ings are crossed by an irregular basal, median, and post-median brown nds of darker spots, shaded with deeper brown internally. The trans- cent spots of the upper side reappear on the lower side of the fore ings.

Early Stages—The larva feeds on clover and other plants.

Distribution—The insect is found throughout the United States and anada, but is not yet reported from the central masses of the Rocky ountain region (Holland). Dyar gives it in his list. We have not ken it in the state. Wiley's collection contains one specimen from iles City, June, 1893; Coubeaux has two specimens from near Big ndy, 1904.

Genus SCELOTHRIX.

THE GRIZZLED SKIPPER, Scelothrix centaurea, Rambur.

Fig. 104.

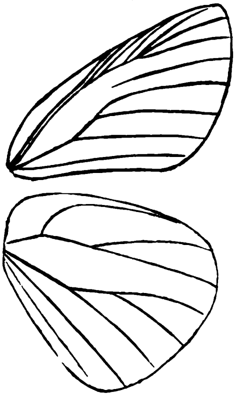


Fig. 104. **Venation of Scelothrix.**

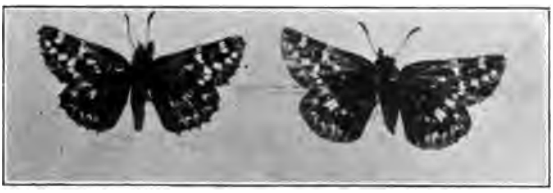


Fig. 105. **Sceiothrix Centaurea.**

Butterfly—Expanse, about 1.25 inches, 31 mm. Upper surface black, nged with brown, sprinkled somewhat with white scales over the basal lf. There is a bar of white in the end of the cell of the fore wings, less distinct spot of the same below the middle of the cell, and a sub- rminal row of white spots. There are first three spots in the sub-costal interspaces three-fourths of the distance from the base to the apex; two spots beyond the cell, the upper half way from the third spot to the margin; spot five inline with the first three; and an oblique row of four more,—two in the median interspaces and the other two in the medio-submedian interspace, one next to each vein. Besides this, the cross vein at the end of the cell has some white scales. In addition to these, there are five white spots on the costal edge.

The hind wings have two obscure rows of white spots, the first crossing the end of the cell, the spot on the cell being the most distinct; the second sub-terminal, consisting of a series of inter-venular, somewhat sagittate spots. Fringes white, cut with black at the ends of the veins.

Under side a little paler than the upper, sprinkled over with white scales so as to be grayish brown. The spots of the fore wings are repeated, but enlarged and coalescing. The hind wings have three distinct bands of white, one near the base which does not show on the upper side, consisting of three patches united; the middle one enlarged and blended; the sub-terminal one not much more prominent than on the upper surface.

Body black above, with gray hairs, the scales and hairs below white; antennae annulate with black and white; top of club ferruginous.

Distribution—From the Atlantic coast in New York, West Virginia and North Carolina westward to Colorado, north to Montana. In Montana it has been taken by Elrod at Sinyaleamin lake in the Mission mountains (two); Brandegee has one in his collection from Presto Pass, near Helena; Cooley has one from Shields river at elevation of 9,000 feet. These two last are small and quite dark, but have the characteristic markings of the species.

THE SMALL CHECKERED SKIPPER, Scelothrix scriptura, Boisduval. Fig. 106.

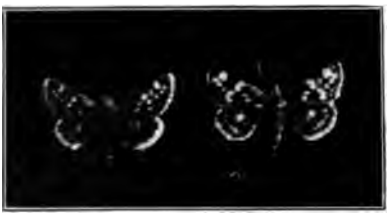


Fig. 106. **Scelothrix scriptura.**

Butterfly—Small, expanse .85 inch, 21 mm. The hind wings on the upper side are about entirely dark gray, the only white being a spot or two at the end of the cell. The fore wings above marked somewhat as in **centaurea.** On the under side the fore wings are blackish toward the base, with the costa, the apex, and the outer margin narrowly whitish. The hind wings below are pale, with an incomplete median band of white spots and broad white fringes, which are not checkered with darker color as in the preceding species.

Early Stages—These are unknown.

Distribution—We have not seen it in the state, nor is it in any of the collections we have examined. It is reported from California, Arizona and Montana.

Genus HELIOPETES Billberg, Helopetes syrichtus, Fabricius.

This species is reported by Edwards among the specimens collected by Carrington and Logan in 1871.

Genus PYRGUS.

THE CHECKERED SKIPPER, Pyrgus montivaga Reakirt, or Hesperia tessellata, Scudder. Fig. 106a.

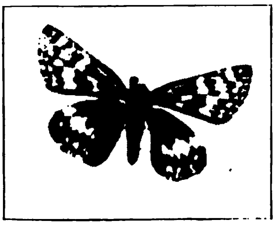


Fig. 106A. **Pyrgus montivaga.**

Butterfly—Expanse, about 1.20 inches, 30 mm. Male: Upper surface black, the basal third and hind margin of fore wings overlaid with white hairs, as also the inner part of the hind wings. The outer two-thirds of fore wings contain about thirty white spots arranged somewhat in four irregular transverse rows; and five more on the costal edge. The hinds wings have about eighteen spots, arranged in three rows, the spots of the inner row the largest, the middle ones crescent, the outer ones points. Fringes white, with black at the ends of the veins.

Under side of fore wings yellowish white along the costa and the outer margin, the spots of the upper surface repeated, but more or less blended, the space between the spots brownish black. Hind wings white, faintly yellowish; a spot near the base, two irregular transverse bands, and a marginal row of lunules are brownish, these corresponding to the spaces between the rows of white above.

Female—Darker, owing to the spots being smaller, the marginal row of points sub-obsolete. Under side also darker.

Distribution—From Pennsylvania to the Gulf of Mexico, from the Atlantic to the Pacific. In the state it has been taken by Barnes at Aldridge (one); by Elrod at Flathead lake (one) and at Swan lake (one); Wiley has many specimens in his collection from Miles City; Coubeaux has collected it in the Bear Paw Mountains. Collected by Coues along the northern border in 1874.

Genus HESPEROPSIS.

THE LENA SKIPPER, Hesperopsis lena, Edward.

Butterfly—Expanse, male, 1.1 inches, 28 mm., female 1.15 inches, 30 mm. Upper side dark brown, glossy; primaries have three small white spots, with traces of a fourth, in an oblique bar from costa, at four-fifths the distance from base to apex; a small spot in cell near outer end; and three minute spots in median and submedian interspaces, two being in the latter, these about three-fifths the distance from base to hind margin. Secondaries immaculate. Fringes concolored.

Under side of primaries dark brown, grayish at base and over apical area, more particularly when seen obliquely. Secondaries gray-brown, caused by a uniform sprinkling of whitish scales over the brown surface; without spots except a transverse abbreviated white dash on middle of disk.

Female—Color of the male; the white spots conspicuous, forming a discal row quite across primaries; a large spot in cell, and a small one in submedian interspace near base. Under side of both wings as in the male, except that the three costal spots of discal row are repeated, and the spot in cell, but all are reduced.

From one male and one female taken in Montana by Mr. Morrison, 1881. In all four examples were taken.

We have not tken it, nor have we seen any specimens we could refer to the species. Dyar says he has not seen any certainly determined specimens.

Genus PHOLISORA, Scudder.

The Sooty-wing, Pholisora catullus (Phol-i-so'ra ca-tul'lus) Fabricius... Plate XII, and Fig. 107.

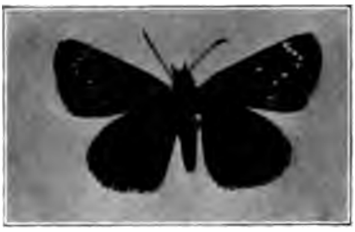


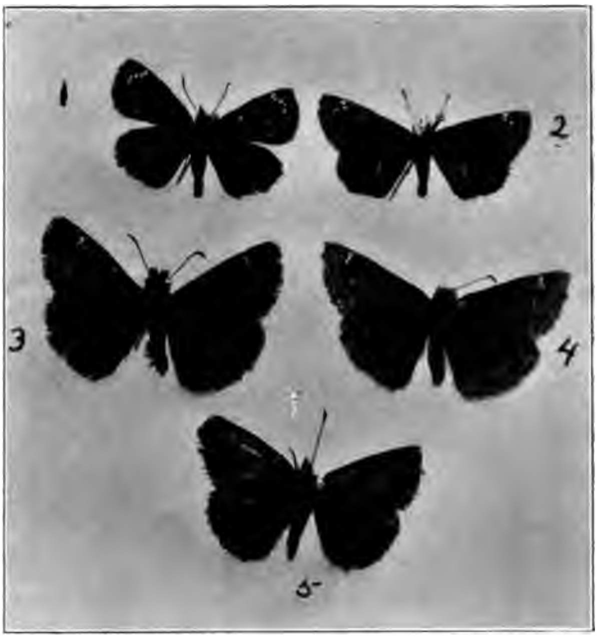
Fig. 107. **Pholisora catullus**, silghtly enlarged.

Butterfly—Expanse, .80 to 1.15 inches. Brownish black on both sides of the wings, with a faint marginal series and a conspicuous submarginal series of light spots on the primaries. In the male on the upper side, and in addition to these, in the female, a faint marginal series on the secondaries. On the under side only the upper spots of the submarginal series of the primaries reappear. The body and head are black above, the head with three longitudinal white stripes, the ends of the palpi hairs the same color; the palpi and head white beneath, the body blacfl. Fringes concolorous with the wings.

Early Stages—The larva feeds on Monarda, Chenopodium, Ambrosia, and others. It forms a case for itself by folding the leaf along the midrib and stitching the edge together with a few threads of silk. It lies concealed during the day and feeds at night.

Distribution—It is found over the whole of temperate North America. At Missoula, in the state, it has been taken abundantly. Wiley has in his collection one specimen taken June 7, 1891, another June, 1893, both from Miles City; Coubeaux calls it rather common around Big Sandy.

Brandegee has one specimen from Mt. Ascension, near Helena, June 29, 1902.



Pholisora catullus, 1, 2, upper and lower sides.
Thanaos persius, 3, 5 upper side, 4 under side.

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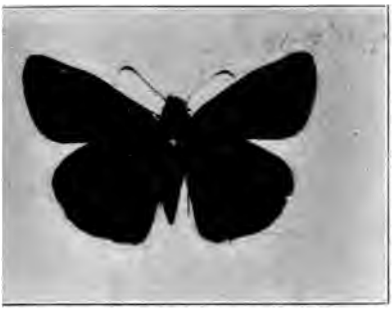
ASTOR, LENOX AND
TILDEN FOUNDATIONS.

Genus THANAOS, Boisduval.

tterfly—Antennae have a moderately large club, curved, bluntly 1. The palpi are porrect, the third joint almost concealed in the second. All dark in color.

PERSIUS' DUSKY-WING, Thanaos persius, Scudder.



8. **Thanaos persius**, from Helena.

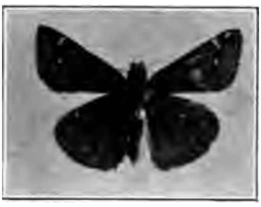


Fig. 109. **Thanaos persius.**

tterfly—Expanse, 1.2 to 1.4 inches, 30 to 35 mm. Upper surface rown with a row of small white spots before the apex of the fore-and a single one posterior to these. On the fore wings there is a erse pale band just beyond the middle of the wings, but this band as well defined as in **T. lucilius**, which is found in the eastern part United States. Hind wings more of a reddish brown than the ings, with two rows of indistinct ochraceous spots near the outer ., and a spot at the end of the cell in typical specimens.

derside of the females grayish brown, the apical portion of the fore gray; the white hyaline spots are repeated, and both wings have arginal rows of whitish spots. The males are darker than the s.

e species is subject to great variation, some specimens being light hers dark in color. Holland says "There is scarcely any positive the specific identity of the insect except that which is derived he study of the genital armature of the male, which is a micr-research capable of being performed only by an expert in such s."

rly Stages—The caterpillar feeds on willow and poplar.

stribution—From New England across to the Pacific, southward as In the state it has been taken by Elrod at Missoula and in the Mis-ountains; by Douglas and Smith at New Chicago; by Cooley at an, by Brandegee at Helena, and by Coubeaux at Big Sandy.

AFRANIUS' DUSKY-WING, Thanaos afranius, Lintner.

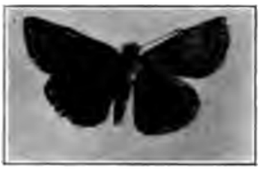


Fig. 110. **Thanaos afranius.**

Butterfly—The hind wings on the upper side in the male are almost solid black, the fringes paler. On the underside there is a double row of light spots along the margin of the hind wing in both sexes. On the upper side the female is generally lighter in color than the male.

Early Stages—Unknown.

Distribution—Common in Arizona. Given in Dyar's list. We have not taken it. One specimen from Bozeman, one from Helena, and one from unknown locality we have referred to this species.

Subfamily PAMPHILINAE.

In this subfamily is included the greater number of our smaller skippers; however, some of the species are larger in size than many of the Hesperiinae. All of our tawny skippers belong to this subfamily, as well as some black or dark-brown species. The antennae usually have a stout club, with a short recurved tip; sometimes this tip is wanting. Fig. 112 shows plainly the venation. In the majority of our species the males can be recognized by the brand; this is a conspicuous dark patch crossing the disk of the fore wings obliquely. This brand is a complicated organ, composed of tubular scales, the **androconia,** that are the outlets of scent glands, and of other scales of various shapes; the brand is wanting in some species.

The **Pamphilinae** are difficult to study, owing to the slight differences in allied species. Either sex, moreover, resembles the same sex of other species much more closely than it does the opposite sex of the same species; and the difficulty is further augmented from the fact that in several species there are two distinct forms of females which differ from each other more than either does from the females of certain other species. These species have three forms, one male and two female.

Key to Genera.

1.	Antennae with the point of the club absent; end obtuse	2.
	Antennae with the point of the club present; end sharp	4.
2.	Fore wings of male with a linear stigma.	
	Fore wings of male without a linear stigma	3.
3	Under surface of hind wings with silvery whites pots	**Pamphila**
	Under surface of hind wings without silvery white spots	**Oarisma**
4.	Antennae with the point of the club short, less than width of club	5.
	Antennae with point of club long, equal to or greater than the middle of club	9.

5.	Antennae in length twice the width of thorax	6
	Antennae short, equal to the width of thorax.	
6.	Male stigma with modified scales below	7.
	Male stigma without modified scales below	Ochlodes
7.	Stigma apparently continuous	8.
8.	A small black area below stigma	Thymelicus
	An obscure, weak fulvous area below stigma	Erynnis
9	Mid tibiae with long distinct spines	
	Mid tibiae not, or very feebly spined	10.
10.	Male with a stigma	Limochroes.

Genus PAMPHILA, Fabricius.

THE ARCTIC SKIPPER, Pamphila palaeman, Pallas. Fig. 111.

Fig. 111. **Pamphila palaemon.**

Butterfly—Expanse, 1.10 inches, 27 mm. This butterfly is wholly unlike any other species, and is easily recognized from other skippers of our fauna. The figure shows the markings. The upper side of the wings is dark brown conspicuously marked with yellow spots. The fore wings of the male lack the brand; the spots on the lower side of the hind wings are silvery white.

Early Stages—The caterpillar feeds on grasses.

Distribution—The insect ranges from southern Labrador as far south as the White Mountains and the Adirondacks, thence westward, following a line north of the Great Lakes to Vancouver's Island and Alaska. It ranges southward along the summits of the mountains as far as Southern California. Taken in the state by Cooley near Bozeman. One taken at Flathead lake.

Genus OARISMA, Scudder.

THE POWESHEIK SKIPPER, Oarisma powesheik.

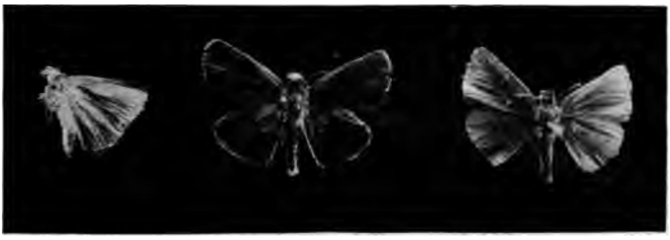


Fig. 111A. **Oarisma powesheik.**

Butterfly—Expanse, 1.2 inches, 30 mm. The club of the antennae lacks the terminal hook. The upper surface of both fore and hind wings is dark brown; the costal margin of the fore wings to near the apex is dull yellow; the fore wings of the male lack the brand. On the under side the fore wings are black, edged on the costa and outer margin for a short distance below the apex with light fulvous. The veins and nervules of the hind wings are white, standing forth conspicuously upon the darker ground color.

Early Stages—Unknown.

Distribution—It occurs in Illinois, Iowa, Nebraska, Dakota, and Montana. In the state it has been collected by Coubeaux near Big Sandy, 1904; by Cooley at Bozeman, July 18, 1901, and by Wiley at Miles City (7), three July 4, 1892, two June 2, 1893, and two June 17, 1899.

THE GARITA SKIPPER, Oarisma garita, Reakirt, may be expected in Montana. It is light fulvous on the upper side, with the costa of the hind wing somewhat broadly marked with leaden grap; on the under side the fore wings are brighter fulvous, with the inner margin lined with dark gray. The hind wings are paler fulvous, inclining to gray, with the inner margin bright fulvous. Expanse, .75 to 1.00 inch, 19 to 25 mm.

Genus ERYNNIS, Schrank.

Butterfly—The antennae are short, less than half the length of the costa; the club is robust, with a terminal crook. There is a discal stigma on the fore wings of the male. The egg is somewhate spherical. The caterpillar feeds upon grasses. The chrysalis is elongated and cylindrical.

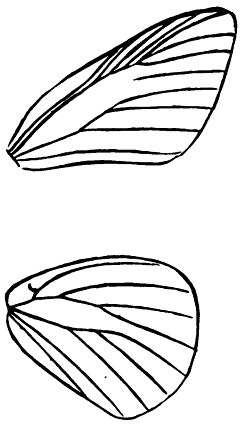


Fig. 112. **Venation of Erynnis.**

THE UNKAS SKIPPER, erynnis unkas, Edwards. Figs. 113, 114.

Butterfly—Expanse, 1.35 to 1.6 inches, 34 to 40 mm.

Female—Upper surface fuscous, the base and posterior part of the fore wings, and a broad band through the hind wings from the base out, washed with dusky fulvous. The fore wings have a sub-terminal broken row of spots, all whitish but the last, which is yellowish, also a small spot at the end of the cell; the two between the branches of the median vein with the outer angles much extended. Hind wings with the sub-terminal spots of the under side showing through a little.

Under side fuscous gray, sprinkled with pale yellow scales. The spots on the upper surface of the fore wings are repeated, white in color, those of the sub-terminal row blended into three groups, the lower widened posteriorly, so as to suffuse most of the posterior angle area. The hind wings have two very much bent white bands, the outer not reaching the inner margin.

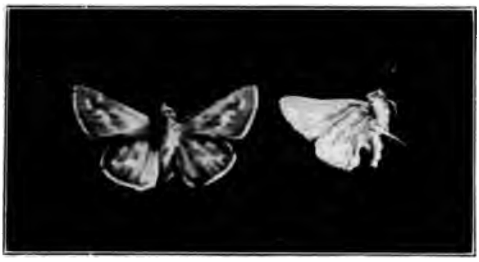


Fig. 113. **Erynnis uncas.**

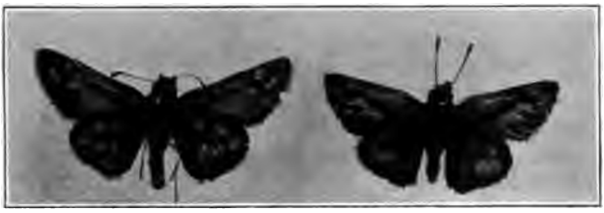


Fig. 114. **Erynnis uncas.**

Male—Upper surface fulvous, the hinder portion washed with yellow, a row of five yellow spots in the outer fulvous field. Stigma very oblique, narrow, jet-black, contracted in the middle.

Hind wings washed with yellow, inclining to fulvous in the central part; fringes white, fuscous at base. Under side as in the female.

On the under side of this species the wings are beautifully marked, the spots reappearing from the upper as pearly white ones on greenish gray brown.

Early Stages—These are unknown.

Distribution—It ranges from Delaware westward to Colorado and Montana. In the state it has been taken by Elrod at McDonald Lake in the Mission Mountains (1), at Missoula (2), at the Biological Station at Flathead Lake abundantly, and also in the Park at Mid-geyser basin (2). Cooley has collected it at several places in the vicinity of Bozeman. Allen has collected in at Dillon.

THE COMMA SKIPPER, Erynnis comma, Linnaeus.

Butterfly—The following is taken from Scudder's description of **Pamphila nevada,** which Dyar gives a synonym for **colorado,** which is the form taken in Montana.

"The males differ from all the other species of this genus in the clearness of the upper surface of the wings; occasionally the wings are somewhat suffused with dusky, but usually the hind wings have but a narrow edging of blackish, broadened, naturally, along the costal border; and the fore wings, instead of having a distinctly limited bordering, as is common to a greater or less extent in most species, have the wing gradually more and more suffused with a warm bud dusky tint toward the tip, as is not unfrequently the case in **P. comma**. Sometimes the mesial belt of the under surface is isible above, but occasionally, at least, it is wholly absent. The female scarcely differs, upon the upper surface, from the females of **P. comma**, except in almost uniformly having the small subapical spots, both those near the costal, and those near the outer border, paler than the others, or nearly white, as occasionally happens in the females of **P. comma**. Beneath, the mesial white band of the hind wings is more irregular and scattered than in **P. comma**. In the male it is usually broken up into four patches, connected, by their angles only, into a continuous angular belt; three of these patches, of nearly equal size, but the middle one usually the largest, lie in a straight line parallel to the longer axis of the wing, situated one each in the subcostal and subcosto median interspaces, as far from the outer border as the second patch; the medio-submedian spot further removed from the border than the rest; the ground color of the wing is a greenish griseous, and the spots are narrowly edged exteriorly and interiorly with blackish. The markings of the female are similar, excepting that they are usually a little larger and more obviously continuous,often sending out on the exterior border little shoots of white along the nervules."

This species with its many varieties is found in Europe, America and Asia. In the Canadian Entomologist of 1883, Vol. XV, is an interesting discussion by Dr. A. Speyer and W. H. Edwards relative to the comparison of specimens from different localities.

There are the following varieties recognized in Dyar's list, Bulletin 52, U. S. Nat. Mus.; oregonia, columbia, colorado, idaho, nevada, assiniboia, laurentina, manitoboides, juba, viridis, manitoba. In his later revision of the group, Journal N. Y. Entomological Society, September, 1905, he thinks three or four names will suffice. **Laurentina** Lyman, **colorado** Scudder equals **manitoba** Scudder equals **nevada** Scudder, **columbia** Scudder, **idaho** Edwards equals **assiniboia** Lyman he refers to the synonym of **comma**.

The varieties are distinguished about as follows:

Hind wings below dark brown, spots moderate	laurentina
Hind wings below green, spots often reduced	colorado
Hind wings below grayish green, the spots often small and tending to form a straight row; smaller than the other forms	columbia
Hind wings below light yellow or greenish	idaho

Distribution—This is a European species, found in Northern United States, the Pacific States, and in the Rocky Mountain States. Dr. Coues collected the variety **colorado** along the northern border in 1874. It has been taken by Barnes at Aldridge, and by Brandegee at Helena.

THE PAWNEE SKIPPER, Erynnis pawnee, Dodge.

Male expanse, 1.45 inches, 36 mm. Primaries above fulvous. Subcostal, submedian and subdorsal veins black at the base. Stigma black and conspicuous, followed by a dusky shade. A small black line at the extremity of the disk is preceded by a yellowish white or semi-transparent spot in the disk; a similar spot, triangular in shape, appears between the first and second median veinlets at their divarcation, and two others between the sixth and seventh subcostal veinlets. The outer margin is broadly bordered with brown, which is finely powdered with fulvous scales toward the apex.

Two nearly square fulvous spots between the last subcostal and first median veinlets, separate an oval brown patch that lies at the extremity of the disk, from the border. Costal edge blackish. Fringe white, dusky toward the apex.

Secondaries fulvous, bordered with brown; broadly and darkest along the anterior edge, narrowly on the outer edge, where it appears as cuneiform spots between the veinlets, and broadly along the innner edge, where it is sprinkled with fulvous. Most of the veins on both wings are black. Underside of both wings yellow. Primaries black at base, having a black line corresponding to the stigma.

Inner margin brown, preceded by a large whitish patch. Five pale whitish spots near the apex, another in the disk, and one between the first and second median veinlets. Fringe white at the anal angle, brown tipped with white at the apex. Secondaries have a whitish spot in the disk, and are crossed by a nearly straight row of small whitish spots. Head and thorax greenish yellow. Body black. Abdomen, breast and palpi yellowish white. Antennae black and yellow above, white tipped with chestnut below. The spots on the under side of secondaries sometimes obsolete.

Female, light brown above, with a slight purplish reflection. Primaries sprinkled with fulvous scales near the base and inner edge. There is a large, square, white spot in the disk, and an unequal, curved row of nine white spots extend from the costa—beginning about two-tenths of an inch from the apex—to the submedian vein. The first three spots are narrow and equal, the fourth and fifth are small and square and lie nearest the outer edge of the wing, the sixth is large and triangular, the seventh largest and square, the eighth and ninth are irregular in shape and partly fulvous.

Secondaries darkest along the anterior margin. A curved row of five whitish yellow spots, of which the second and third are longest, crosses the wing beyond the disk, and in the disk is a small yellow spot. A yellow streak precedes the last median veinlet, run to the outer margin. Fringe of all the kings white. Below, on the primaries, the same white spots appear as above, except that th eeighth and ninth are merged in a large whitish patch situated as in the male. A brown patch covers part of the base and inner margin, and extends to the center of the wing. On the secondaries three small white spots appear near the apex. The ground color of both wings is yellowish white, most deeply tinged with fulvous near the costal border of the primaries. Fringes white. Head, thorax and body brown above. Abdomen and palpi white. Antennae black above, whitish tipped with red below. This species was taken at Glencoe, Nebraska, upon high rolling prairie, from the first to the middle of September.

The above is the original description, copied from Canadian Entomologist, Vol. VI, No. 3.

Distribution—The Western plains, Utah and Nebraska,, according to Dyar. Given in "List of Butterflies taken by H. K. Morrison in Dakota and Montana, 1881," in Canadian Entomologist, Vol. XIV, 1882. We cannot tell from this list whether it was taken on the plains of Dakota or Montana.

THE WOODLAND SKIPPER, Thymelicus sylvanoides, Boisduval.

Butterfly—Expanse, 1.25 to 1.34 inches, 31 to 34 mm.

Male, upper side fulvous, darker at outer edge; a black stigma, large; several (three) light spots near outer angle, beyond stigma. Female, upper side with less fulvous, the wings prevalently fuscus, and the red color reduced to a spot at the end of the cell; a median band of fulvous spots on both wings. On the under side in both sexes the wings are quite pale gray, with the costa near the base and the cell of the primaries reddish. The primaries at the base near the inner margin are blac. The spots on the under side reappear, but are pale and faint. This is to be expected in the state, but we have not seen the species among the collections.

Early Stages—Unknown.

Distribution—The species ranges along the Pacific coast from British Columbia to California, and eastward to Colorado.

Genus OCHLODES, Scudder.

THE INDIAN SKIPPER, Ochlodes sassacus Harris. Fig. 115.

Butterfly—Expanse, 1.2 to 1.4 inches, 30 to 35 mm.

Male—Upper surface fulvous, dark brown or balck through the discal cell and along the border, the base dusky. A black, oblique stigma or sex-mark below the cell.

Under side pale fulvous, the posterior part fuscus; the five subterminal spots of the upper surface repeated, a spot at the end of the cell, a large triangular patch, with dentate outline, all yellowish white. The hind wings have a sub-terminal band of six whitish spots across the anterior two-third of the wing, and a spot at the end of the cell.

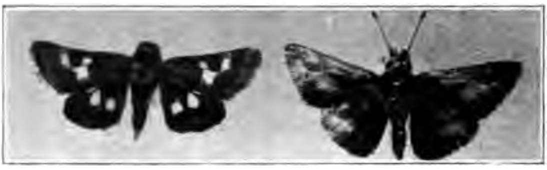


Fig. 115. **Ochloedes sassacus, female on left, male on right.**

Fig. 116. **Ochloedes sassacus,** upper and lower surfaces of male.

Female—This is larger, the fulvous ground color paler, the outer marginal shades darker, and the discal stigma is replaced by a dark brown shade. The fore wings have a row of eight yellow spots, and two elongate spots, more or less distinct, in the outer part of the cell.

On the under side the spots of the fore wings are repeated, pale, the lower of the outer row broadly expanded.

Body brown above, with grayish hairs, lighter beneath.

Early Stages—The caterpillar feeds on grasses.

Distribution—From New England to Florida, westward to Colorado and Montana. In Montana collected by Elrod at Missoula (9), at McDonald Lake in the Mission Mountains (3), and in numbers of the University of Montana iological Station. Douglas and Smith collected it at Wiles Hot Springs (14).

Genus LIMOCHROES, Scudder.

The antennae are about half as long as the costa; the club is robust, elongate, with a very short terminal crook; the palpi have the third joint erect, short, bluntly conical. The male has a linear discal stigma on the upper side of the fore wing. The egg is hemispherical, somewhat flattened on the top. The larvae feed on grasses, and construct a tube-like nest of delicate films of silk between the blades.

THE CROSS-LINE SKIPPER, Limochroes manataaqua, Scudder.

Butterfly—Expanse, 1.00 to 1.20 inches, 25 to 33 mm.

In the male the wings are dark brown marked and tinged with yellow; the brand is very slender and nearly straight; outside of it there is a patch of brown scales, which makes it appear wider than it is; between the brand and the costal margin the wing is heavily covered with yellow scales, and the transverse row of spots beyond the middle of the wing is more or less distinct; the hind wings are tinged with yellow, sometimess the transverse row of spots is faintly indicated.

In the female the wings are dark brown above with a transverse row of whitish spots beyond the middle of the fore wing; hind wings without spots.

Distribution—The species is reported to have a general distribution over the United States. It has been collected by Cooley at Bozeman.

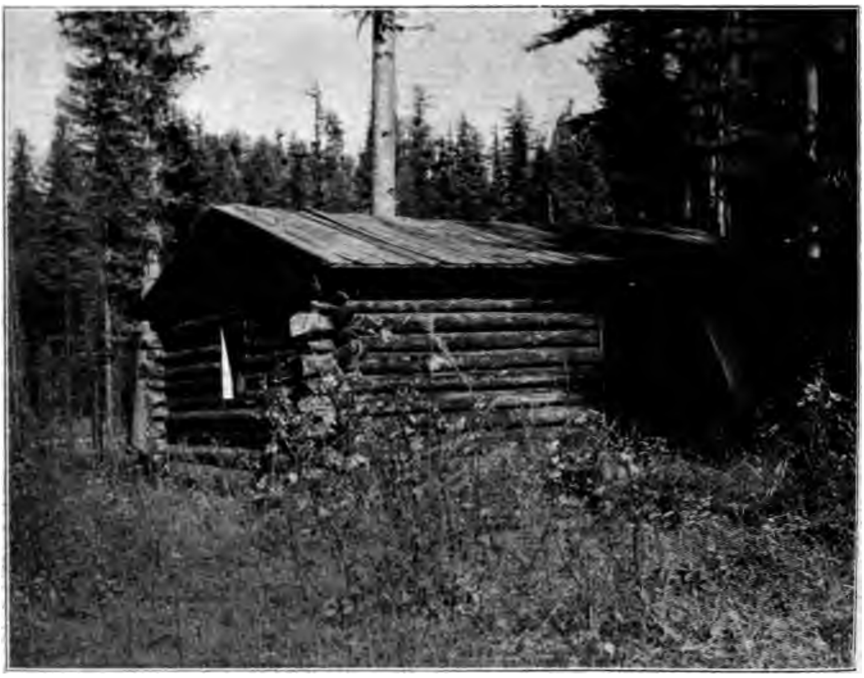


Fig. 117. Old cabin at Swan Lake, where Vanessa j. album, the Compton tortoise shell butterfly, was taken in great numbers.

List of Species of Butterflies Collected by Campbell Carrington and William B. Logan, of the Expedition, in 1871.

By W. H. Edwards.

Papilio rutulus, Boisduval.—Junction.
    turnus, Linn.—Montana.
Parnassius smintheus, Doubleday.—Junction; Yellowstone.
    clodius, Menetus.—Montana.
Pieris protodice, Bois. (Printed **Pinis protodin.**)—Several localities.
Anthocaris ausanoides, Bois.—Hot Springs.
Colias eurytheme (printed **enegthenu**), **Bois.**—Hot Springs.
    philodice (printed **philodin**), **Godart.**—Hot Springs.
    alexandra, Edwards.—Yellowstone.
    astraea, Edwards.—Colorado.
Argynnis edwardsii, Reakirt.—Junction.
    montivaga, Behr.—Junction.
    meadii, Edwards.—Colorado.
    myrina, Cramer.—Colorado.
Melieta (spelled **Meletaea**) **hofmanii, Beahr.**—Junction.
Phyciodes tharos, Boisd.
Grapta satyrus, Edwards.—Hot Springs.
Pyrameis huntera Drury.—Montana.
Vanessa antiopa, Linn.—Montana.
    milberti (spelled **melbertii**), **Godart.**—Bozeman City.
Coenonympha ochraces, Edwards.—Virginia City.
Erebia rhodia, Edwards.—Yellowstone.
    haydenii, Edwards, new species.—Yellowstone.
Satyrus nephele, Kirby.—Yellowstone.
    silvestris, Edwards.—Virginia City.
    sthenele, Bois.—Virginia City.
Chrysophanus rubidus, Edwards.—Stinking Creek, (Mont).
Lycaena anna, Edwards.—Pleasant Valley.
    acmon, Bois.—Meadow River. (Mont.)
Pyrgus syrichtus, Fab.—Montana.
Herpena comma, Linn.—Virginia City.

In addition to the above were several specimens, especially of **Lycaenidae,** that were too much injured for recognition.

W. H. EDWARDS,
January, 1872. Coalburgh, West Virginia.

EREBIA HAYDENII, Edwards, New species.

Male: expanse, 1.6 inches.

Upper side fuscous, immaculate; under side a shade paler, much irrogated with gray scales; primaries immaculate; secondaries have a complete series of black ocelli along the edge of hind margin, one on each interspace; each ocellus narrowly ringed with ochraceous, and having minute white pupil.

The above is copied from "Preliminary Report of the United States Geological Survey of Montana and Portions of Adjacent Territories: Being a Fifth Annual Report of Progress. By F. V. Hayden." This is the report for 1871, printed in 1872.

Plate XIII.

THE NEW YORK
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ASTOR, LENOX AND
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Glossary.

Abbreviated, as applied in Biology, shorter than the ordinary type.

Abdomen, the posterior part of the body.

Aborted, imperfectly developed; redimentary.

Aciculate, needle-shaped, more slender than subulate.

Acuminate, terminating in a long tapering point.

Albino, an animal or plant exhibiting an abnormal deficiency of coloring matter.

Alpine, as applied in Biology, inhabiting a mountain region above the limits of forest growth.

Anal, pertaining to the posterior part of the body.

Anal angle, the inner or posterior angle of the hind wings, next to the body.

Angulate, having angles.

Annulate, furnished with colored rings.

Antennae, two articulated organs of sensation, situated on the head.

Anterior margin, the front margin if the wing; the costa.

Apex, that part of the wing which is farther from the body; the angle between the costa and the outer margin.

Ashen or ashy, ash-colored.

Aureus, golden yellow.

Basal, relating to the base.

Base, as applied to a wing, that part which is joined to the body.

Bifid, cleft.

Bipupillate, applied to an ocellate spot having two pupils or dots within it of a different color from the rest of the spot.

Body, the three parts of an insect, head, thorax, abdomen.

Boreal, pertaining to the north.

Bronze, the color of old brass.

Buff, a brownish-yellow color.

Capillary, hair-like; long and slender, like a hair.

Carinate, keeled; having a longitudinal prominence like the keel of a boat.

Caterpillar, the larva.

Cavdate, tailed:—generally applied to the posterior wings of Lepidoptera to indicate tail-like projections.

Cell, usually in Lepidoptera the space between the subcostal and median veins; the discal cell.

Chitine, the hard part on the outside of insects.

Chrysalis, the third stage of the insect, counting the egg one.

Ciliate, fringed.

Clavate, club-shaped.

Coalesce, to grow together or unite.

Collar, scales back of the head, forming more or less of a ring; the neck.

Concolorous, of the same color, as the body agreeing in color with the wings.

Confluent, running into each other.

Coniferous, cone-bearing.

Connivent, conveying or approaching.

Conoidal, tending to a conical form.

Contiguous, touching; placed so near as a touch.

Convergent, approaching each other towards the tip.

Cordate, heart-shaped.

Corrugated, wrinkled.

Costa, the thickened anterior part of the wing from the base to the apex.

Cremaster, the anal hooks of the chrysalis, which fasten into silk to hold the chrysalis in place.

Crenate, scalloped.

Cretaceous, chalky.

Cruciferous, pertaining to the Cruciferae or mustard family of plants.

Cubitus, the second longitudianl vein of the fore wing.

Cuneiform, wedge, shaped.

Cupreous, coppery; the color of copper.

Dentate, toothed.

Diaphanous, semi-transparent, clear.

Dichotomous, forked; dividing by pairs.

Diffuse, spreading.

Dimorphous, two-formed:—applied to a species existing in two forms having different colors or markings.

Discoidal, disk-shaped.

Disk, the surface within the margin,—usually between the end of the cell and the outer margin.

Diurnal, as applied to Lepidoptera, active during the day.

Divergent, tending in different directions.

Dorsal, of the back.

Dorsum, the back or upper surface.

Echinate, set with prickles.

Edematous, dull translucent white.

Edge, the margin.

Egg, the first stage of an insect.

Ellipsoid, pertaining to a solid every plane of which is an ellipse or circle.

Elliptical, in the form an ellipse.

Emarginate, notched.

Entire, the margin smooth, or without teeth.

Entomology, the branch of zoology that treats of insects.

Epysillate,applied to an ocellate spot included in a colored ring, but destitute of a pupil or central dot.

Excision, a cutting off or out.

Eyes, the organs of sight, composed of numerous hexagonal facets.

Fasciated, banded.

Fauna, the animal distribution of an era, or of a stated period.

Fawn-color, light yellowish brown.

Ferruginous, of the color of iron-rust.

Filiform, thread- shaped.
Foveae, shallow rounded depressions or pits.
Frontal, pertaining or relating to the front.
Fuliginous, sooty; soot-colored.
Fulvous, orange-yellow.
Fuscous, dark brown with slight mixture of gray.
Fusiform, spindle-shaped.
Geminate, situated in pairs.
Gemmate having buds.
Generic, pertaining to a genus.
Genus, an assemblage of species which correspond in particular characters
Globular, like a round ball.
Glutinous, slimy, viscid.
Granulated, covered with small grains.
Gregarious, living in society, or many feeding together.
Habital, a situation or locality frequented by insects.
Head, the anterior part of the body.
Hibernaculum, a case of web and leaves in which larvae or pupae hibernate, or a cocoon of silk.
Hibernate, to pass through or survive the winter.
Hind margin, that part of the fore wings which is included between the base and the posterior angle.
Hirsute, rough with strong hairs.
Hoary, covered with a fine white silvery substance or pubescence.
Humeral, the vein in the humerus.
Humerus, the anterior base of the wing.
Hyaline, transparent; vitreous.
Hybrid, an animal or plant produced from the mixture of different breeds, species or genera.
Imago, the perfect or adult insect.
Imbricated, tiled; placed one over another, like shingles on the roof of a house.
Immaculate, without spots.
Incanous, hoary.
Inconspicuous, not readily discernible.
Inner margin, that margin of the hind wings which extends from the base to the anal angle; by some authors used to denote the posterior or hind margin of the fore wings.
Inscriptions, markings.
Involute, coiled specially as certain antennae.
Iridescence, a many colored appearance.
Iris, of an ocellate wing spot, is a circle that surrounds the principal spot.
Irrorate, sprinkled.
Joints or Articulations, the divisions of thebody or segments of the larva; the divisions of the pupa, more particularly the abdomen; the divisions of the antennae.
Labial palpi, articulated filaments, one on each side of the labium.
Labium, the lower tip.

Labrum, the upper tip.
Lanceolate, lance or spear shaped.
Larva, the second stage of an insect, counting the egg the first.
Lateral, situated on the side.
Laved or washed, covered with scales of a color different from the ground color, but not quite obscuring the latter.
Lenticular, lens-shaped.
Lepidoptera, an odler of insects having four wings covered with minute imbricated scales; butterflies and moths.
Lethargic, becoming torpid or inactive.
Linear, narrow and of nearly uniform width.
Lineated, streaked or marked with lines.
Livid, dark gray, verging towards violet.
Longitudinal, the direction of the longest diameter.
Lunate, crescent-shaped; formed like a new moon.
Lunule, a crescent-shaped marking.
Lurid, of a dirty brown color.
Lustrous, shining.
Maculate, or maculated, spotted.
Mandibles ,the upper jaws.
Margin, the edge of wing, or along the edge.
Maxillae, the lower jaws, placed between the upper jaws and the lower lip.
Median, middle.
Mesial, middle, as a band or stripes across the middle portion of the wing.
Mesothorax, that division of the thorax to which the middle pair of legs are attached.
are attached.
Metamorphoses, transformations.
are attached.
Moult, or Molt, shedding or casting off the larva skin.
Nebulous, clouded.
Nervule, a small nerve or nervure.
Nervures, divisions of the nerves or veins of a wing.
Neuration, or Venation, the arrangement of the veins of the wings.
Niger, black a little tinged with gray.
Obconic. inversely conic.
Obcordate, inversely heart-shaped.
Oblong, the transverse diameter much shorter than the longitudinal.
Obviate, inversely egg-shaped.
Obsolescent, growing obsolete.
Obsolete, indistinct.
Occiput, the hinder part of the head.
Ocelli, eye-like spots on the wings of Lepidoptera; single eyes of insects.
Ochreous, yellow with a slight tinge of brown.
Olivaceous, olive-green.
Opaque, having no luster, dull.
Orbicular, round.
Order, the subdivision of a class.
Oval, broadly elliptical.

Ovate, egg-shaped.

Overlaid, heavily sprinkled with scales of a different color from the ground color; clouded; overcast.

Palpi, in butterflies, the three jointed organs beneath the head between which the tongue is coiled like a watch-spring.

Perianth, as applied in Botany are the floral leaves that inclose the young sporophylls.

Petiole, of a leaf, the stalk-like portion that bears the blade.

Piceous, pitchy; the color of pitch.

Pika, a tailless hare found in the Rocky Mountains.

Pile, very minute, short hairs.

Pileated, crested; cap-shaped.

Pilous, having long, sparse hairs.

Polymorphous, applied to a species existing in several different forms as to color, markings, or size.

Porrect, straight out.

Posterior angle, the angle formed by the outer margin and the posterior or hind margin of the fore wing.

Posterior margin, that portion of the fore wings which is opposite the costa.

Postmedia vein, a vein lying between the media and cubitus.

Premedia vein, a vein lying between the media and radia.

Primaries, the fore wings of Lepidoptera.

Proboscis, the tongue or sucking organ.

Pronotum, the anterior part of the covering of the thorax, the covering of the thorax.

Prothorax, the first division of the thorax, to which the first pair of legs are attached.

Protuberant, bulging.

Pruinous, hoary; covered with a whitish powder.

Pubescent, coated with fine hair or down.

Punctured, marked with small empressed dots.

Pupa, the third stage of an insect, country the egg the first; the chrysalis.

Pupate, to assume the pupa form.

Pupil, of an ocellus, the central point.

Quadrangular, having four angles.

Quadrate, square, or nearly square.

Radius, a vein of the wing; the subcostal.

Remote, separate; not near together.

Reniform, kidney-shaped.

Reticulate, resembling net-work.

Retractile, capable of being exserted or drawn in at pleasure.

Retuse, ending in an obtuse sinus.

Ribs, ridges on eggs from the base to the apex.

Roseate, of a rose color.

Roseus, rose color.

Rufous, reddish.

Rugose or Rugous, wrinkled.

Russet, reddish or yellowish brown.

Sagittate, arrow-shaped.

Sanguineous, of the color of arterial blood.

Scabrous, rough, with projecting points.

Scales, the dust or imbricated pieces covering the wings.

Secondaries, the hind wings of Lepidoptera.

Segment, a ring or division of the body.

Sericeous, silky.

Serrate, saw-toothed.

Sessile, connected with the part to which it is attached without the intervention of a peduncle or stalk.

Seta, a bristle.

Sinuate, indented.

Sinuous, curving, winding or folding.

Sinus, an indention of execution.

Sparse, scattered.

Species, an assemblage of individuals possessed of permanent characteristics of size, color, and ornamentation, by which they may be distinguished from other forms, and which breed true to their type.

Spinous, armed with spines.

Spiracle, breathing-holes on the side of the body; the stigmata.

Sporophylls, as applied to Botany, leaves which produce only spores.

Sprinkled, marked with thinly-scattered scales of another color than the ground color.

Stigmata (singular Stigma), the breathing-holes on the sides of the body; also, sometimes, spots on a wing.

Stigmated, resembling stigmata.

Striae, lines; transverse elevated lines on eggs.

Striate, marked with lines.

Stridulator, a locust, grasshopper, or other insect that makes a musical or shrill sound by rubbing together specially hardened parts of the body.

Subapical, situated below the apex.

Subcosta, the subcostal vein, situated behind and near the costal vein of an insects wing.

Submarginal, applied to a space or line within the margin.

Subocellate, applied to an ocellus without a pupil.

Suffused, blurred with a color other than the usual one.

Sulphureous, bright yellow; the color of sulphur.

Tail, the terminal segment of the abdomen; an appendage at the posterior part of the hind wings.

Tarsi, the feet.

Tawny, dull yellowish brown.

Terminal, at the extremity

Testaceous, tile or brick color.

Thorax, that part of the body which is back of the head.

Tibia, that part of the leg which is next to the foot.

Tippet, one or two scale-like appendages of the pronotum of Lepidoptera.

Tongue, the sucking-tube of Lepidoptera.

Tosidity, a lethargic state of hibernation.

Translucent, semi-transparent.

Transverse, crosswise.
Trochanter, an appendage at the base of the thigh.
Trophi, the mouth parts.
Truncate, cut square off.
Tubercle, a small swelling or prominence.
Undulating, vibrating; wavy.
Umbel, as applied to Botany, a flower-cluster in which a number of the same length spring from the same point, thus radiating like the stays of an umbrella.
Variation, a deviation in function or structure from the usual form, but not breeding true to type.
Veins and Venules, the frame work of tne wings.
Venation, see neration.
Venter, the lower part of the body.
Ventricose, distended.
Verticillated, arranged in a circle around an axis.
Villi, soft hairs.
Violaceous, violet color.
Vitellinus, yellow with a slight tinge of red.
Vita, a longitudinal colored line.
Washed, see laved.

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ERRATA.

Page 3, seventh line from the bottom, read **edwarosii** for **edwardsi.**
Page 5, sixth line from bottom, read **Lycaena** for **lycana.**
Page 14, for Fig. 13, read Fig. 14.
Page 15, for Fig. 14, read Fig. 13.
Page 66, eleventh line from the bottom, read **zolicaon** for **zolicoan.**
Page 97, third line from top, for Branedgee read Brandegee.
Page 111, seventh line from bottom, for **Spiraca** read **Spiraea.**
Page 112, tenth line from bottom, for **Lycaona** read **Lycaena.**
Page 112, twenty-third line from bottom for **Basilachia** read **Basilarchia.**
Page 112, fifth line from bottom, for **sminthcus** read **smintheus.**
Page 140, first line of fourth stanza, for whitness read whiteness.
Page 143. In the key, after **Hesperopsis** read P. 147; after Scelothrix read P. 145; after **Heliopetes** read P. 147; after **Pyrgus** read P. 147; after **Pholisora** read P. 148; after **Thanaos** read P. 149.
Page 151. In the key, after **Ochlodes** read P. 156; after **Thymelicus** read P. 156; after **Erynnis** read P. 152; after **Limochroes** read P. 157.
Page 156. After **THE WOODLAND SKIPPER** read **Thymelicus.**
Page 159. Seventh generic name from top, read **Melitaea** for **Melieta.**

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BULLETIN UNIVERSITY OF MONTANA, NO 34
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A List of the Fishes of Montana

With Notes on the Game Fishes

by

James A. Henshall, M. D.

Superintendent of Bozeman Station, U. S. Bureau
of Fisheries.

AUTHOR OF "Book of the Black Bass",
"Camping and Cruising in Florida",
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"Bass, Pike, Perch and
Others", Etc., Etc.

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"INDEPENDENT PUBLISHING COMPANY, HELENA, MONTANA."

LETTER OF TRANSMITTAL.

Prof. O. J. Craig, University of Montana:

Dear Sir:—This paper was presented to the Montana Academy of Sciences, Arts and Letters, at its second annual meeting held at Anaconda, Mont., December 29-31, 1903. The Academy has not developed sufficient strength to have its transactions printed. Dr. Henshall's paper contains matter that is worthy of permanent record as a contribution to the natural history of the state, and will be followed by a more elaborate paper with keys and descriptions. I therefore recommend its publication as a bulletin of the University.

MORTON J. ELROD,
President Montana Academy of Sciences, Arts and Letters.

Fishes of Montana.

By Dr. James A. Henshall, U. S. Bureau of Fisheries.

But thirty-six species of fishes have so far been recorded as native to the waters of Montana, as embraced in the following catalogue. Several of the species have been identified from the descriptions of Lewis and Clark, but most of them were collected by the Government Railroad Surveys in the Missouri River below the Great Falls, and of late years a few have been collected by the U. S. Bureau of Fisheries.

Family ACIPENSERIDAE.

1. **Scaphirynchus platorynchus** (Rafinesque.) Shovel-nose Sturgeon.
   Missouri River at Fort Benton.

Family SILURIDAE.

2. **Ictalurus punctatus** (Rafinesque). Channel Catfish; White Catfish.
   Missouri River at mouth of Beauchamp Creek and at Great Falls; Milk River; Yellowstone River.
3. **Noturus flavus,** Rafinesque. Stone Catfish.
   Missouri River, near Craig.

Family CATOSTOMIDAE.

4. **Carpiodes velifer** (Rafinesque). Quill-back; Carp Sucker.
   Milk River; Poplar River.
5. **Pantosteus jordani,** Evermann. Jordan's Sucker.
   Sweet Grass Hills; Red Rock River; Beaverhead River.
6. **Catostomus discobolus,** Cope. Big-mouth Sucker.
   Red Rock River; Beaverhead River.
7. **Castostomus griseus** (Girard). Gray Sucker.
   Milk River; Yellowstone River; Gardiner River; Poplar River.
8. **Catostomus catostomus** (Forster). Long-nose Sucker.
   Little Blackfoot River; Jocko River; Lolo Creek; Browns Gulch Creek.
9. **Catostomus macrocheilus** (Girard). Columbia River Sucker.
   Swan Lake; Post Creek; presumably in Flathead Lake.
10. **Catostomus commersonii** (Lacepede). White Sucker.
   Milk River; Poplar River.
11. **Minytrema melanops** (Rafinesque). Spotted Sucker.
   Yellowstone River.
12. **Moxostoma aureolum** (Le Sueur). Red Horse Sucker; Mullet.
   Poplar River.

Family CYPRINDAE.

13. **Hybognathus nuchalis,** Agassiz. Silvery Minnow.
   Poplar River.
14. **Hybognathus argyritis,** Girard. Little Silvery Minnow.
   Milk River.

15. **Pimephales promelas,** Rafinesque. Black-head Minnow.
Milk River; Yellowstone River.
16. **Mylocheilus caurinus** (Richardson). Columbia River Chub; "Whitefish." Flathead Lake; Bitter Root River.
17. **Ptychocheilus oregonensis** (Richardson). Squaw-fish.
Flathead Lake; Bitter Root River; Lolo Creek.
18. **Leuciscus balteatus** (Richardson). Banded Minnow.
Brown's Gulch Creek, at Silver Bow.
19. **Notropis atherinoides,** Rafinesque. Silverside Minnow.
Poplar River.
20. **Rhinichthys cataractae dulcis** (Girard). Long-nose Dace.
Beaverhead River; Red Rock River; Poplar River; Little Blackfoot River; Browns Gulch Creek; Bridger Creek.
21. **Hybopsis gelidus** (Girard). Cold-water Minnow.
Milk River.
22. **Hybopsis montanus,** Meek. Montana Minnow.
Upper Missouri region.
23. **Couesius dissimilis** (Girard). Milk River Minnow.
Milk River; Poplar River.
24. **Platygobio gracilis** (Richardson). Fat-head Chub.
Milk River; Yellowstone River; Missouri River; Judith River; Poplar River.

Family HIODONTIDAE.

25. **Hiodon alosoides** (Rafinesque). Moon Eye.
Missouri River Falls; Poplar River.
26. **Hiodon tergisus,** Le Sueur. Toothed Herring.
Missouri River; Judith River.

Family SALMONIDAE.

27. **Coregonus williamsoni cismontanus,** Jordan. Rocky Mountain Whitefish. East Montana generally.
28. **Salmo clarkii,** (Richardson). Red-throat Trout.
Both slopes of the Rocky Mountains.
29. **Cristivomer namaycush** (Walbaum). Mackinaw Trout; Lake Trout.
Elk Lake, Madison County.
30. **Salvelinus parkei** (Suckley). Bull Trout; Dolly Varden Trout; Red spotted Trout.
Rattlesnake Creek, and west Montana generally.

Family THYMALLIDAE.

31. **Thymallus montanus,** Milner. Grayling.
Tributaries of the Missouri above the Great Falls.

Family GASTEROSTEIDAE.

32. **Eucalia inconstans** (Kirtland). Stickleback.
Poplar River.

Family PERCIDAE.

33. **Stizostedion canadense boreum** (Girard). Northern Pike-perch.
Great Falls of the Missouri; Milk River; Marias River.

Family SCIAENIDAE.

34. **Aplodinotus grunniens,** (Rafinesque). Fresh-water Drumfish.
Milk River.

Family COTTIDAE.

35. **Cottus semiscaber** (Cope). Bull-head; Blob.
Streams of east and west Montana, generally.

Family GADIDAE.

36. **Lota maculosa** (Le Sueur). Ling.
Red Rock River; Red Rock Lake; Poplar River; Missouri River.

To this list may be added the following species planted in Montana waters by the U. S. Bureau of Fisheries:

Family SALMONIDAE.

Coregonus clupeiformis (Michill). Lake Superior Whitefish.
Planted in Flathead Lake.

Salmo gairdneri, Richardson. Steelhead Trout; Salmon-trout.
Planted in numerous streams in Montana.

Salmo irideus, Gibbons. Rainbow Trout.
Planted in numerous streams in Montana.

Salmo fario, Will. Brown Trout; Von Behr Trout.
Gallatin County, Hoffman's Ranch.

Christivomer namaycush (Walbaum). Mackinaw Trout; Lake Trout.
Flathead Lake.

Salvelinus fontinalis (Mitchill). Eastern Brook Trout.
Numerous waters in Montana .

Family CENTRARCHIDAE.

Micropterus dolomieu, Lacepede. Small-mouth Black Bass.
Micropterus salmoides (Lacepede). Large-mouth Black Bass.

The two species of black bass, principally the large-mouth, have been planted in some waters of the western portion of the state, on the Pacific slope, where the water is much warmer than in eastern Montana; and in the Missouri River near Great Falls, also in a lake just above Great Falls, formed by the dam of an electric power company. The colder waters of the eastern part of the state are totally unsuited to black bass; moreover, they should never be planted in ponds or streams containing trout.

Family PERCIDAE.

Perca flavescens (Mitchill). Yellow Perch.

The yellow perch has been introduced in the artificial lake mentioned, near Great Falls, where they have multiplied to such an extent as to afford good fishing.

In 1889 and 1890 there were planted in the waters of the Yellowstone National Park yearling fish of the following species by the U. S. Bureau of Fisheries:

Date.	Place.	Species.	Number.
Sept. 22, 1889	Gardiner River	Brook Trout	4,975
Sept. 15, 1890	Gardiner River	Brook Trout	7,875
Sept. 22, 1889	Gibbon River	Rainbow Trout	990
Sept. 22, 1889	Firehole River	Loch Leven Trout	995
Sept. 2, 1890	Lewis Lake	Loch Leven Trout	3,350
Sept. 2, 1890	Shoshone Lake	Loch Leven Trout	3,350
Sept. 22, 1889	Gardiner River	Mountain Trout	968
Aug. 9, 1890	Shoshone Lake	Lake Trout	18,000
Aug. 23, 1890	Shoshone Lake	Lake Trout	7,262
Aug. 23, 1890	Lewis Lake	Lake Trout	7,263
Sept. 2, 1890	Lewis Lake	Lake Trout	4,750
Sept. 2, 1890	Shoshone Lake	Lake Trout	4,750
Sept. 15, 1890	Nez Perces Creek	Von Behr Trout	9,300
Oct. 3, 1899	Twin Lakes	Native Whitefish	2,000
Oct. 15, 1899	Yellowstone River	Native Whitefish	980
Aug. 15, 1890	Yellowstone River	Native Whitefish	5,000
Sept. 11, 1890	Yellowstone River	Native Whitefish	5,000

Excepting the Yellowstone and Gibbon Rivers, and possibly the east fork of the Gardiner, there were previously no fish whatever in any of these streams or lakes.

As one result of these plantings there have been taken in the Madison and Yellowstone rivers or tributaries in Montana the eastern brook trout, the rainbow trout and the Von Behr or brown trout.

Owing to the great size of the state of Montana, with its climatic peculiarities and the consequent differences in the temperature and condition of the waters of the east, west and northern portions, it is remarkable that so few species of native fishes have as yet been discovered. It is but fair to state, however, that its waters have not been fully explored, and additions to its fish fauna will no doubt result from more thorough investigations of its streams and lakes.

It will be noticed that but few food-fishes, good, bad or indifferent, are included in the foregoing list of native fishes. Those of the Missouri below the falls being the channel catfish, the several suckers, the northern pike-perch and the fresh-water drumfish. By far the best game- and food-fishes are those of the mountain streams, as the redthroat trout, grayling and Rocky Mountain whitefish of the eastern slope of the Rockies, and the Dolly Varden or bull trout of the west slope. They are the most important for the angler or for the table, and thrive in the cold streams of both sides of the Continental Divide. If proper legislation was enacted to prevent their destruction by irrigating ditches they would soon become abundant in all suitable waters.

The law prohibiting the sale of trout and grayling is the most important, and in fact the only one, for fish protection in the statutes of Montana, and were it repealed the fishes of the mountain streams would soon be few and far between.

In view of their importance perhaps it may be well to refer more particularly to the fishes of the salmon family, both native and introduced, in order that their merits may be more fully recognized and better laws adopted for their preservation.

THE RED-THROAT TROUT (Salmo Clarkii).

The red-throat trout, or native trout, is the most widely distributed of all the native fishes of Montana. It inhabits both slopes of the Rocky Mountains, and, as might be inferred from this extensive range, it varies in external appearance more than any of the trout species. There are a dozen or more well-defined sub-species or geographical varieties, but all have the characteristic red splashes on the membrane of the throat. By means of this "trade-mark" it may be readily distinguished from the rainbow or steelhead trouts, both of which are also black-spotted.

But while the red-throat trout varies considerably in contour, coloration and markings, in different localities, it is identical in structure wherever found. It is known by the U. S. Bureau of Fisheries as the "black-spotted trout," a most unfortunate designation, inasmuch as the rainbow and steelhead trouts are also "black-spotted." The name red-throat trout is distinctive, and is preferable to the rather repulsive name of "cut-throat" trout by which it is also known. The red-throat trout is designated in Montana by such names as "trout," "brook trout," "speckled mountain trout," etc. As the eastern red-spotted "brook trout" is rapidly being introduced to our waters, the name "brook trout" should be applied only to that species.

Where the red-throat trout grows to a larger size than usual, as in the Yellowstone and other lakes, it is often called "salmon-trout", and the bull trout of the west slope is also sometimes known by the same name, but the only "salmon-trout" is the steelhead trout. The red-throat trout rises to the fly more freely than eastern brook trout, though in gameness and flavor it is hardly its equal. Its habits are also somewhat different. It usually lies in pools and holes, and does not frequent the riffles so much as the eastern trout. In size it is somewhat larger than the eastern trout in streams of the same relative width and depth, and like all trout species grows bigger in lakes and large streams. I have taken them on the fly weighing from three to five pounds in Soda Butte Lake in the Yellowstone Park, and in Yankee Jim Canyon on the Yellowstone River. It seldom breaks water when hooked, but puts up a vigorous fight beneath the surface. In Yellowstone Lake it is infested with the white pelican parasite, rendering it emaciated and lacking in game qualities; this condition, however, seems to be disappearing somewhat, while those in the river are well-nourished and gamy. Under favorable conditions it grows rapidly. One taken from a pond near Toston, supplied from Bozeman Station, weighed three pounds, dressed, when two years old.

THE STEELHEAD TROUT. (Salmo gairdneri).

The steelhead, or salmon-trout, is the trimmest and most graceful and the gamest of all the trout species, being more "salmon-like" in shape and appearance. On the Pacific coast, where it is native, and runs to salt water, it grows to twenty pounds or more in weight, when it is known as steelhead salmon, and many are packed under this name. Its spots are smaller than in the other black-spotted species. It has, usually, especially the males, a pink flush along the sides, but not so pronounced as in the rainbow trout. Its color is also of a lighter hue, with steely reflections. Its scales are somewhat larger than those of the red-throat, but not so large as in the rainbow.

During the past six years the U. S. Bureau of Fisheries has introduced the steelhead in a number of streams and lakes in Montana, which seem to be very suitable for this fine fish. They have been caught during the past year or two as heavy as four pounds, which shows that they have come to stay. The steelhead rises eagerly to the artificial fly, and breaks water repeatedly when hooked; it is very trying to light tackle, and must be handled carefully by the angler. As a food-fish it excels all other trout, as might be surmised. It should grow to eight or ten pounds in lakes of considerable area and depth, and where its food is plentiful.

THE RAINBOW TROUT. (Salmo irideus).

The rainbow trout has also been introduced to Montana waters during the past few years by the U. S. Bureau of Fisheries, and seems to be well-adapted to ponds of considerable extent, where water plants and grasses flourish. Such waters seem to be more congenial than the colder mountain streams; and moreover it has a way of disappearing from the smaller streams to seek those of greater depth. It will thrive in warmer water than the other trouts. The rainbow is similar in contour to the red-throat, though somewhat deeper, and with shorter head, smaller mouth, and larger scales. Its distinguishing feature is the broad red band along the lateral line, common to both male and female. It is a handsome fish, with considerably more gameness than the red-throat, but is not so vigorous on the rod as the steelhead of the same size. Owing to its tendency to descend streams it is particularly liable to enter irrigation ditches, in which event its doom is sealed. As a food-fish it is superior to the native red-throat trout.

THE BROWN TROUT. (Salmo fario).

The brown trout is the brook trout of Europe, and was introduced to the United States from England and Germany, under the auspices of the U. S. Bureau of Fisheries. Those from Germany, (the eggs), were donated by Von Behr, and his name was unfortuately applied to the fish as "Von Behr trout," also "German trout." As the fish is universally known in Great Britain as the "brown trout", that name should be adhered to in this country as well. It is the trout of Izaak Walton, and the German names are cerainly inapplicable. In Germany it is known as "bach-forelle", which means "brook trout." It is neither so gamy nor so good a food-fish as our own trouts, though it grows quite large in suitable waters, or those of higher temperature than required for our native trouts.

It has both reddish-brown and black spots, of a larger size than those of its American cousins. In 1899 a lot of fingerlings were supplied by the U. S. Bureau of Fisheries, to Hon. C. W. Hoffman, who placed them in a pond on his ranch, a mile from Bozeman. Last summer (1903) two were taken from the pond weighing six pounds, a remarkable growth in four years; though this weight was doubtless attained at the expense of the small trout of other species in the same pond. I saw a mounted specimen that was taken in a tributary of the Yellowstone near Livingston that was said to weigh ten pounds when captured, which was probably correct, as it was thirty inches long.

THE BROOK TROUT. (Salvelinus fontinalis),

The eastern brook trout has both crimson and yellowish spots, with dark marblings on the back. At spawning time the males have the lower part of the body bright scarlet, of a more intense color than the other species mentioned. The paired fins are bordered with both black and white lines. It is the most beautiful of all the trouts. As a game- and food-fish it ranks high, but is excelled in game qualities by both the rainbow and steelhead, which, however, is no disparagement. It has been introduced of late years from Bozeman Station to many ponds and streams thoughout the state, where it has uniformly done well. One was taken on the fly from the pond of Mr. Hoffman, previously referred to, that weighed three and one-half pounds at three years of age. I also know of two being taken from a tributary of the Madison, near Ennis, where they were planted by the U. S. Bureau of Fisheries, that weighed respectively one and one-half and two pounds at one and a half years of age. Two of the same hatching were taken the same autumn of like weights in Bridger Creek. The low temperature of the east Montana waters seems to be eminently suitable for the brook trout.

The DOLLY VARDEN TROUT. (Salvelinus parkei).

The Dolly Varden, or bull trout, sometimes erroneously called "salmon-trout," is the only red-spotted trout native to western waters. It belongs to the same genus as the eastern brook trout, but grows much larger. It is found in Montana only on the Pacific slope in both lakes and streams, growing to twelve or fifteen pounds under favorable conditions. In the streams it is a gamer fish than in lakes, though the larger fish are rather lazy and logy. Compared with its eastern relative it is hardly so vigorous on the rod, when of similar weight, and not quite so good for the table.

THE LAKE TROUT. (Cristivomer namaycush .

The lake trout is closely allied to the eastern brook trout, though it grows very much larger, and is confined to very deep lakes. In the Great Lakes it often reaches forty pounds in weight, and is stictly a commercial fish, though it is often taken by deep trolling with the minnow. It never rises to the artificial fly. I have taken it on the trolling spoon In the Straits of Mackinaw, and in the bay at Marquette on Lake Superior. It is one of the best fresh-water food-fishes. Its spots are large and of a grayish coloration.

In the books it has never been credited to Montana, though it exists in Elk Lake at the head of the Jefferson, but nowhere else so far as I am aware west of of Lake Michigan, which is likewise true of the grayling. It is credited in the books to Henrys Lake, Idaho, but this is a mistake which I corrected a year or two ago. Many years ago it was taken at Elk Lake by Mr. Sawtelle and Mr. Sherwood, of Henrys Lake, and not knowing what it was they forwarded specimens to the Smithsonian Institution, where it was identified as the lake trout. As it was sent from the postoffice at Henrys Lake the inference was that it came from that lake. Henrys Lake is a very shallow body of water, quite weedy, and not at all adapted to this deep water fish. I have collected it from Elk Lake, weighing several pounds. Eggs from Lake Superior whitefish and lake trout have been hatched at the Bozeman Station and several millions of the resultant fry have been deposited in Falthead Lake, where it is hoped they will find a congenial home.

THE GRAYLING. (Thymallus montanus).

The grayling, the "lady of the streams", is as trim and graceful, and withal as beautiful as a damsel dressed for her first ball. Her lovely iridescent colors and tall gaily-decorated dorsal fin, which might be compared to a gracefully waving plume, must be seen fresh from the water to be properly appreciated. The grayling is not only a clean and handsome fish, but is as game as the trout, and in my opinion much better for the table. It was taken in the Jefferson river a century ago by Lewis and Clark, and though they gave a fair description of it in the history of their wonderful expedition, it remained unidentified until it became my good fortune a few years ago to recognize it as the grayling from the description of Captain Lewis.

The grayling is supposed by some to be a cross between the redthroat trout and the whitefish, in other words a hybrid; but I have never seen a hybrid fish in wild waters. Hybrids can be produced by the fishculturist between closely allied species, but the progeny is infertile. The grayling is a distinct species, allied to the salmon family, more distinct in fact than as between the rainbow and steelhead trouts. It is a different species from the Michigan or Arctic graylings, though closely resembling both. It became my good fortune, also, to be the first to propagate the grayling artificially, under the auspices of the U. S. Bureau of Fisheries, it having time and again resulted in failure with the Michigan grayling.

The grayling is found only in Alaska, Michigan and Montana. In Montana it exists only in the tributaries of the Missouri River above the Falls. Its ideal home is in the upper reaches of the Madison and Jefferson. The upper canyon of the Madison and the basin west of the Yellowstone Park are especially adapted to the grayling. There the water is swift, but unbroken, the bottom being composed of dark obsidian sand. In this region grayling of two pounds are not uncommon.

THE ROCKY MOUNTAIN WHITEFISH. (Coregonus williamsoni cismontanus).

For some inexplicable reason this fine game-fish is not properly appreciated by many anglers in Montana. This is probably mere prejudice, but it seems unaccountable when it is considered that there are only two other game-fishes in the eastern portion of the state—the redthroat trout and the grayling. I consider the whitefish equal to the native trout in gameness, as eager in rising to the artificial fly, as ready to respond to bait, and as good, if not better, as a food-fish. Its flesh is firm and flaky, of a sweet flavor, and never has that muddy or earthy taste as in trout from weedy waters.

PADDLE WHEELS FOR DITCHES.

To Prevent Destruction of Fish by Irrigating Ditches.

(From FOREST AND STREAM, March 14, 1903.)

In Forest and Stream of February 14, is an article with the caption "Montana Game and Fish Interests," giving extracts from the semi-annual report of the State Warden, Mr. W. F. Scott. I wish to call attention to certain portions of said report. He says: "It is a matter of serious regret that no practical method has been adopted to prevent the great loss of trout which escape through the irrigating canals and ditches out on to the land, and perish, during the irrigating season, other than the common wire mesh screen which clogs up and retards the flow of water in the spring and autumn when drift matter and leaves are brought down by the current of the stream."

It is both disheartening and discouraging to the western fishculturist to know that millions of fish, both large and small, annually perish through being stranded on the meadows and grain fields as the result of unscreened ditches. He sees a large percentage of the work of the United States and State Fish Commissions go for naught from this cause.

The hardship entailed by the use of the common wire mesh screen exists more in imagination than in reality, for during the season of irrigation in the summer the streams are clear of leaves and trash. "In the spring and autumn when drift matter and leaves are brought down by the the current of the stream," the head gates of the ditches could be closed, for at those seasons rain or snow usually furnishes all the water needed for the crops.

But in order to provide a contrivance "which will not injure or work a hardship on the farmer, and at the same time put an end to this widespread destruction," I have devised an arrangement to be put in at the intake of ditches that is as effective as a screen, but which is not open to its objections, as it permits the passage of such matter as would clog a screen, and at the same time it prevents fish from entering the ditch. I understand that some such device is successfully used in Colorado, but I have not been able to obtain the particulars of its construction.

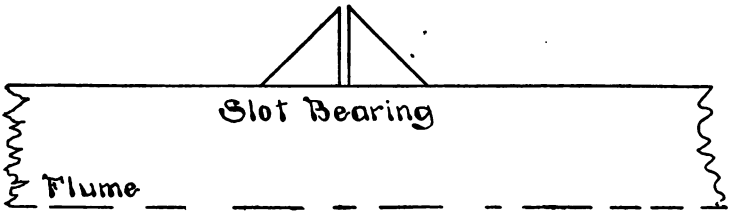
My device is very simple, consisting merely of a short flume at the head of the ditch, with sufficient fall to operate an eight-bladed paddle wheel, fitting the flume closely. The width and depth of the flume, and the size of the paddle wheel would be governed by the width and depth of the ditch. If very wide a double flume and two wheels could be used. In large ditches two old wagon wheels could be utilized by affixing paddles to the spokes. The bearings of the shaft should work in vertical slots, so that any hard substance could pass under the paddles by raising the wheel. The continual splashing of the paddles would be effectual in frightening fish or fry and prevent their passage.

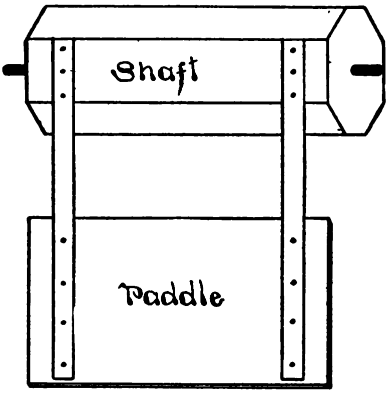
But to make assurance doubly sure, a barrel-shaped frame covered with woven wire of very small mesh, and fitting the flume closely, could be operated as a revolving screen, by utilizing the paddle wheel as a motor. The pulleys to each should be placed on the shafts just outside of the flume, with the belt crossed so as to cause the wheel and screen to revolve in opposite directions, the revolving screen, of course, being at the entrance of the ditch. This forms a self-cleaning screen, all leaves and trash being carried over, while the smallest fish fry are prevented from passing it. I think, however, that the paddle wheel alone would answer the purpose very effectually.

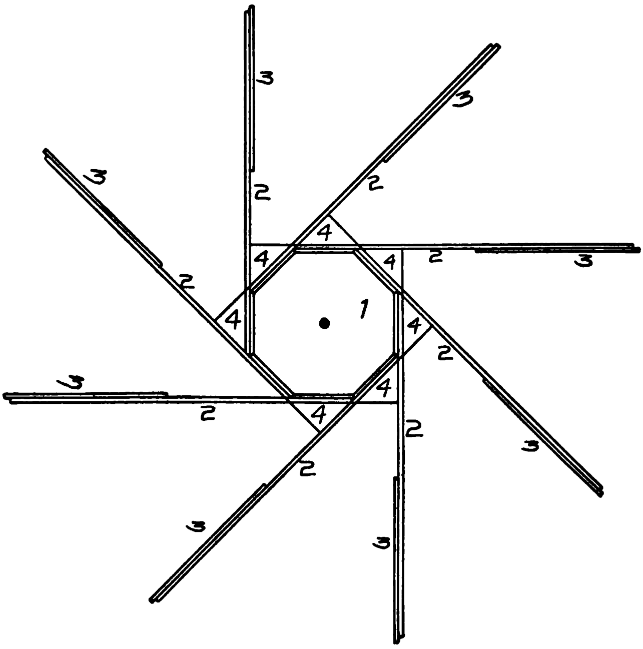
The annexed rough drawings may make the device and its construction more easily understood. For very shallow ditches the paddles might be nailed directly to the octagon shaft. Farmers who are skilled in the use of tools might make a round shaft, with mortises for the arms of the wheel, but it would be no better or stronger than the simple one mentioned.

JAMES A. HENSHALL,

Bozeman, Montana.







CROSS SECTION OF WHEEL.

1. OCTAGON SHAFT. 2. ARMS.
3. PADDLES. 4. BRACES.

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Bulletin University of Montana No. 35,
Biological Series No. 12.

Eighth Annual Announcement
OF THE
University of Montana Biological Station
AT
FLATHEAD LAKE
BIGFORK, MONTANA

Fig. 118. Returning from the mountains.

EIGHTH SESSION, JULY 11 to AUGUST 16, 1906.

Oscar J. Craig, President, University of Montana, Lecturer.

Morton J. Elrod, Professor of Biology, University of Montana, General Zoology, Entomology, Plankton.

Thomas A. Bonser, Science, Spokane High School, Botany.

P. M. Silloway, Superintendent of Schools, Lewistown, Montana, Bird Study.

Gertrude P. Norton, East Helena, Nature Study, Artist.

C. H. Scherf, Science, Flathead County High School, Physiography.

Entered August 24, 1901, at Missoula, Montana, as second class matter, under an Act of Congress, July 16, 1894.

Purposes of the Station.

To serve as a field for research work in Botany, Zoology and Geology. To offer research work to candidates for a degree, such work being accepted by the University of Montana. To furnish a general course to college students, or to those preparing to teach. To make a place for high school students, where they may be permitted to work under the most favorable opportunities. To afford opportunity to teachers to collect material for class use and for their own laboratories. To provide lectures, field excursions, and laboratory exercises so as to give the best insight into the proper method of nature study. To see some of the grandest scenery in the world, and to receive the inspiration felt by those who see grand panoramas. To offer a place where healthful recreation may be had, free from care, under inspiring conditions, accompanied with an environment stimulating observation and investigation. To offer a place where kindred spirits in the state may meet and exchange ideas and by this friendly meeting receive added stimulus and enthusiasm for work.

COURSES OF STUDY.

The following scheme will give those who wish to attend an idea of the kind and character of the work that may be done.

Zoology:—

(a) General Zoology, principally field work, instructions in methods of study and observation, illustrating the influence of environment. An observational study, full of suggestion, very helpful to those who have had no such opportunity for study. Material will be collected and worked up in the laboratory.

(b) Field and laboratory course in Entomology. Instruction in collecting, preserving and labelling insects. Dissection and study of type specimens. A study of injurious insects.

(c) Ichthyology. Special course devoted particularly to the lake and river fishes and their food supply. The course will include plankton study.

(d) Ornithology. A study of birds, with methods of collecting, making and preserving skins; habits and lives of birds of the rich avian region adjacent.

(e) Plankton. A study of the microscopic life of Flathead Lake.

Botany:—

(a) Laboratory and Field Course. Study of type forms of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, and Spermatophytes. Especial attention will be given to the Conifers of the vicinity. There will also be collecting trips in the field, where the various type forms may be found. In the laboratory, attention will be given to the classification of the more common species, to the study of Plant Morphology, to the

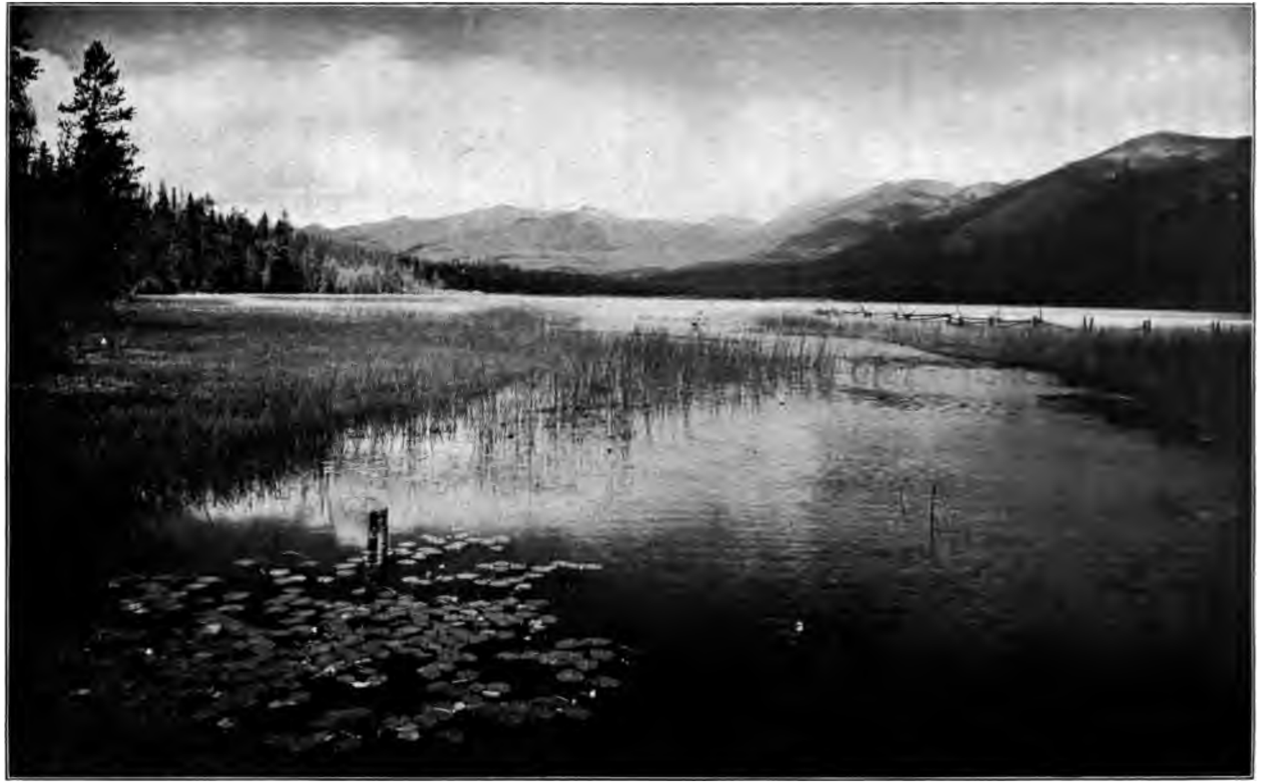

Fig. 119. General view of Rost Lake from the outlet. The Swan Range of the Kootenais is in the distance. Around the lake are tree or forest plant association. Bordering these are meadow societies. In the water are hydrophytic forms.

methods of preparation of Herbarium specimens, and to the methods of preservation in liquid for immediate or permanent use.

(b) Ecology. A general course including local ecological problems, and local plant geography. This region offers quite a diversity in plant societies.

Photography:—

The region offers rare opportunities for this branch of study. The work will include a study of lenses, plates and developers. The use of the ray filter will be explained, and the many errors which may fall to the lot of the beginner will be pointed out. The course will include the selection of subject, development, printing on one or two kinds of paper, and transparencies.

Students in photography must supply their own plates or films and paper. There is a dark room at the laboratory and the scenery in the vicinity gives ample scope for a series of negatives either in landscape or of scientific subjects.

Nature Study:—

A course of study and practical work will be outlined which will afford both a fund of information on which to draw during school work and at the same time secure a collection of material to be used in illustration. The scope of the work will include zoology, botany, geology, and physiography of the region.

Physiography:—

Largely field work. The region furnishes examples of all of the important types of erosion, weathering, ice work, running water, shore work, etc. Sedimentation and diastrophic work are also well illustrated. An attempt will be made to trace the history of a stream, the effects of glaciation on a region, the method of mountain formation, results of sedimentation, and coast forms. Some reading will be done in the field. A copy of Davis, Dryer, or Tarr will be found useful. Geike's Earth Sculpture or any of Russel's books will help. Beside this there will be offered a series of illustrated lectures covering the important topics in physiography. The slides will represent types selected from all parts of the world. This course should be of particular interest to those who teach physical geography, either in the high school or in the grades, for to explain these important things to a class one must have seen them. A summer in the Bigfork region should make any teacher alive in this subject.

Special Work:—

Students and investigators will be encouraged to pursue some special study, taking such problems as may be pursued with profit during the session.

It must be understood that while the daily lectures are given to all, yet each individual works alone, pursuing such study as may be best fitted to his ability and requirements. The beginner has the same opportunity as the advanced student. Realizing that study of biological subjects is not extensive in the state, preparation is made for those who have not pursued such study.

LOCATION.

The University of Montana Biological Station was opened in 1899. For the past seven summers the station has been occupied from June until September or October. During this time some fifteen states have been represented. The Station has become well known to many American naturalists, and all are enthusiastic in their praise of opportunities afforded in the vicinity of Montana's large inland lake.

For scenery the vicinity cannot be surpassed. Few places offer more varied points of interest. The roaring rapids of Swan river are at the door of the building. Flathead lake, covering more than 300 square miles of territory, with its beautiful islands and precipitous shores, has great attractions. The Mission range, beginning on the burnt hills by the laboratory, and rising higher and higher as they extend southward, culminate in snow capped peaks 10,000 feet in height. A few miles to the east is the Swan range, its high summits constantly in view. These two mountain ranges afford some of the most beautiful panoramas to be seen in the Rocky Mountains, and rival the Alps in magnificent scenery. Farther to the east, reached in a short time by pack train, the main chain of the Rocky Mountains breaks the horizon with lofty peaks and precipitous summits. Untrod summits invite the courageous naturalist who seeks the unknown animal and vegetable life. West of Flathead lake are the almost unexplored Cabinets. Within a few miles are many lakes—Swan, Echo, Rost, and others—while many ponds and swamps are in the immediate vicinity. The waters of Swan and Flathead rivers supply Flathead lake, the former at the laboratory door, the latter but two miles distant. East and south of the laboratory the forests extend

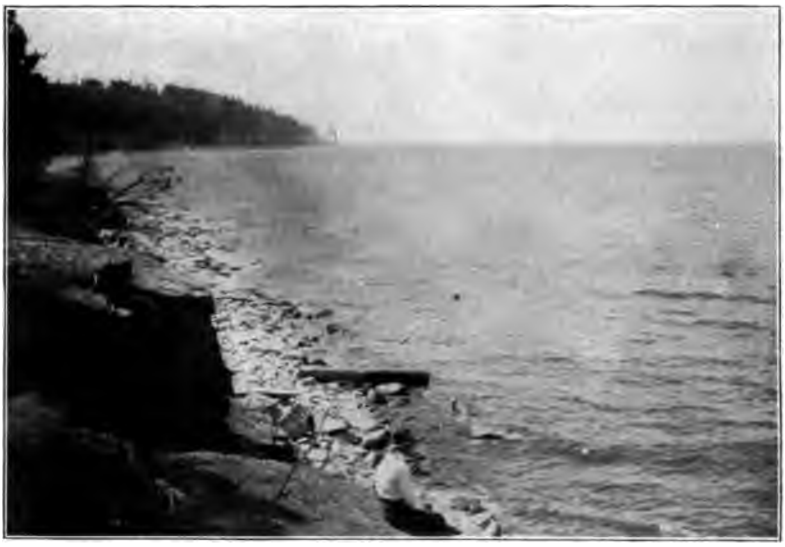

Fig. 120. A bit of Flathead lake, near the Laboratory. Photo by M. J. E.

unbroken for a hundred miles, with here and there a settler's cabin. Such a combination of lakes, rivers, mountains, forests, at elevations from 3,000 to 10,000 feet, one will find in few places in America.

The present site of the Station was chosen because of the advantages mentioned above. The seaside will always have its attractions and its devotees. But there are those who love the mountains, who delight in craggy heights, and who find abundance of material for study because it is new and the field unexplored. There are many who cannot take long trips to the sea shore, others who wish to spend a summer on the inland lakes, in the primeval forest, and among the snow-clad hills. Then there is the home field. Montana needs a wider dissemination of knowledge of outdoor study. Here may be had healthful recreation, beautiful surroundings, congenial associates, and rare opportunities for observation and study.

The climate is delightful. Rarely does it rain in July and August. In the shade it is always pleasant. Long trips may be planned without danger from the elements. One may sleep out without fear. In a day from the laboratory one may reach huge snow banks in middle August. There is an abundance of sunshine, no fogs nor dreary days, and few days of excessive heat.

Further information in regard to the station and its work may be found in the bulletins mentioned later in this circular, and in the following publications: Journal of the New York Botanical Garden, January, 1902, pp. 8-13; Journal of Applied Microscopy, Vol. IV, No. 5, pp. 1269-1278; Science, N. S., Vol. XX, pp. 205-212; Rocky Mountain Magazine, Vol. IV, No. 4, 1901, pp. 781-787.

EQUIPMENT.

The building is a convenient out-door laboratory, with tables for a dozen students. The station work has entirely outgrown the building. Many of the lectures are given out of doors in the yard. The fine summer weather permits of much laboratory work out of doors. There is a dark room for photography. There are three boats which are the property of the station. Other boats may be had at any time. Microscopes, glassware, books and utensils will be supplied from the University. Botanical collecting and drying material will be supplied.

Students in Ornithology must supply their own guns or field glasses. Students in Photography will furnish their own cameras and plates. The necessary chemicals for development will be supplied free. Students who live in tents will supply their own tents and bedding.

UNIVERSITY CREDITS.

Students from the University may pursue study at the Station and receive credit for such work as may be equivalent to University courses. Students taking elementary study may receive preparatory credits.

METHODS OF INSTRUCTION.

The work will consist very largely of field collecting and observation, study of relation to environment, supplemented by laboratory dissections and microscopic examination. The general courses will enable teachers to familiarize themselves with methods of field work, and

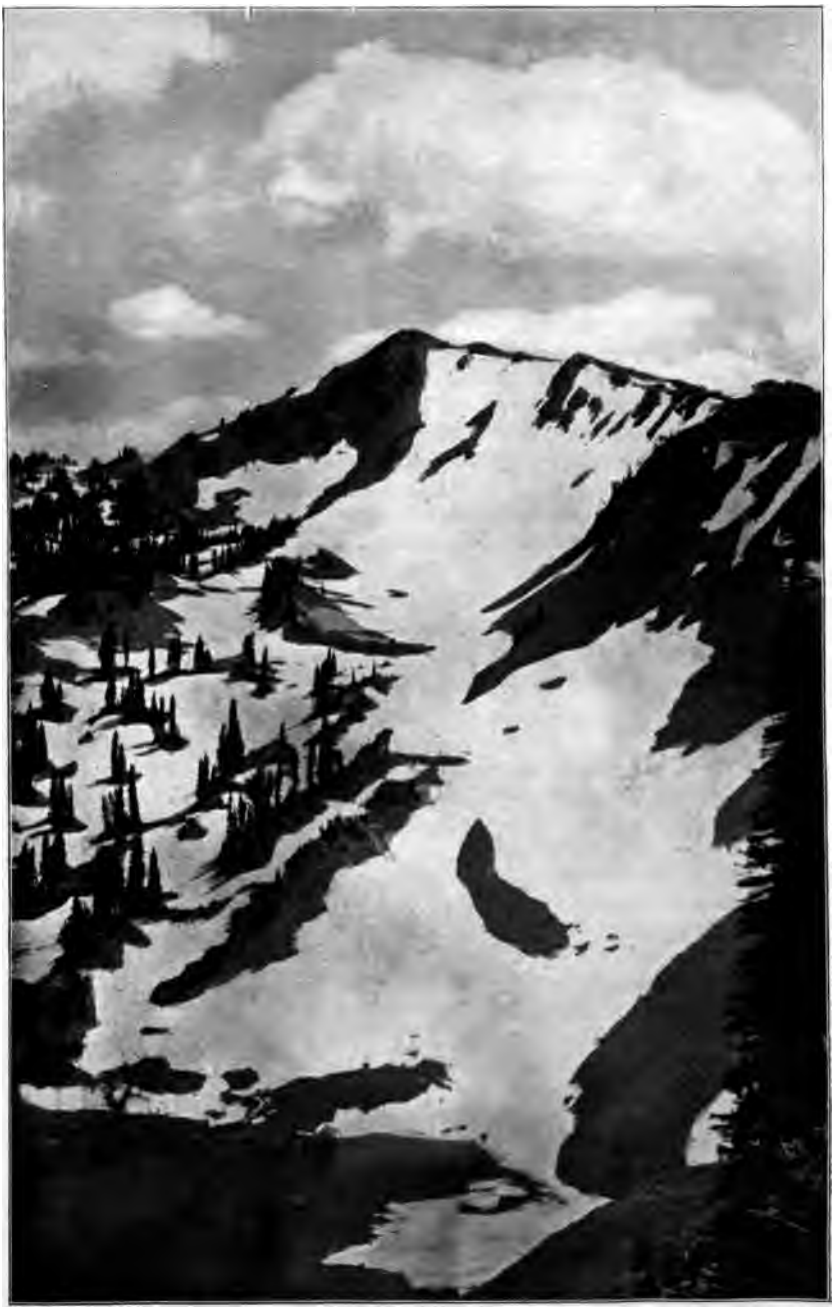

Fig. 121. MacDougal Peak, Swan Range, from the ridge, showing snow field with ice. Photo by M. J. E., August, 1902. The view is south. Altitude of summit, 7725. This summit is visited annually by the station people.

give a store of information from which to draw in nature study subjects. The general courses also give opportunity to students and others to pursue lines of study with better facilities for out-door work with fresh material, than is generally to be had in regular university work.

The expeditions are primarily to give opportunity for the study of animals and plants in their natural environment. By this means more lasting interest is aroused, and more accurate information is obtained.

LECTURES.

Almost every day a lecture on some biological topic will be given at the laboratory. Some of the lectures given in 1902 have been incorporated in Bulletin University of Montana, Biological Series No. 5. Thirteen lectures, covering 90 pages, with 5 plates and 27 figures, are included.

The following lectures will be given during the coming session:

The Debt of Science to Lewis and Clark, with Stereopticon.
The Forests of Flathead Valley.
Montana's Agricultural Water Supply, with Stereopticon.
Studies in Alpine Life, with Stereopticon.
The Mosquito Problem.
The Place of Field Work in Scientific Study.
The Mission Mountains, with Stereopticon.
Evolution of Plant Forms, with Stereopticon.
Evolution of Plant Reproduction, with Stereopticon.
Elementary Forestry.
Plant Societies of the Northwest.
The Coniferae.
Seed Dispersal.
The Ancient History of America.
The History of a River and Some Waterfalls.
The effects of Glaciation on a Region, and Some Glacial Lakes.
Mountains and Volcanoes.
Some Coast Forms.
Mountaineering.
The Deep Sea.

EXCURSIONS.

The following excursions will be taken during the session of 1906, unless the weather is unfavorable:

1. A trip to Swan Lake, through the forests, with stop over night at the lake. This is a beautiful lake in the mountains, of great interest biologically and geologically.
2. A trip to Rost Lake, at the base of the Kootenay Mountains. This is a lake almost filled up, a fine collecting field. It is an admirable location for camps.
3. An ascent of MacDougal Peak via an Indian trail, to an altitude of 7,725 feet. This will afford opportunity for alpine collecting, and will present some of the most sublime scenery in the world.
4. A trip around Flathead Lake, making study of its banks, bays, and swamps.

These trips will be under the personal supervision of the Director of the Station. Those taking the trips must bear a proportionate share of the expense necessary. Such trips will prove of great value and interest biologically aside from the pleasures they bring. These trips are not for mere pleasure, but for scientific study. Daily conferences are held to report on observations and to make suggestions.

HOW TO REACH THE STATION.

Students via Northern Pacific will get off at Ravalli. Stage tri-weekly runs to Flathead Lake (35 miles), connecting with steamer Klondyke, which runs across the lake. Stage fare, one way, $3.00, round trip, $5.00, trunks extra. Boat fare across the lake, one way, $3.00, round trip, $5.00. Stage leaves Ravalli on Mondays, Wednesdays and Fridays, connecting with the steamer, returning the same day. A daily stage, carrying mail and passengers, runs from Ravalli to Polson via Mission and Ronan. Passengers may thus travel to Polson daily. Both stages start from Ravalli, reaching Polson by different routes. They are under different managements.

Students via Great Northern will get off at Kalispell, connecting by stage with the steamer Klondyke at Demersville, a short distance from Kalispell. The steamer will land passengers at Bigfork.

The trip either route is full of interest. There are ample hotel accommodations, and the ride is comfortable and easy, with beautiful scenery always in view.

DATE OF OPENING.

The laboratory work of the Station will begin Wednesday, July 11, and continue five weeks, or until Thursday, August 16. For a week or more before the Station opens some one of the staff will be at or near the Station, and will aid any who may choose to work during such time. The laboratory is at the disposal of students from June 15 to September 1, or even later, if any wish to use it.

BOARD AND ROOM.

Most of those at the Station, including the staff, live in tents. Day board may be had at $4.50 to $5.00 per week. Many prefer to do their own cooking. The stores supply all the necessaries of life, while the region affords an abundance of fruit and vegetables. Daily mail gives easy communication with the outside world. There is also telephone connection. Those who do not wish to live in tents will find suitable accommodations at $6.00 per week for two or $7.00 for one in a room.

RECREATION.

Change is rest. To take a day off and go fishing often gives new lease of life. The tingle of the nerves when the gamey fish tugs at the line is to forget care and to be thoroughly alive. Many will wish to combine an outing with study. In fact, one of the attractions of the place is its natural advantages so as to induce out-door exercise and study. The lake and rivers make rowing a good pastime. The photographer has a field of wondrous richness and varied interest. A fine sand beach makes bathing a delight, and it is indulged in. Unless the lake is stirred by winds the water is warm. The hills and forests afford quiet retreats for study or strolls. The hills and roads give glimpses of scenery of rare beauty. At the proper season hunting is good. Deer have been seen annually a few rods from the laboratory. Grouse and pheasants abound in the hills. In season duck shooting is fine. A day's tramp will take one to the home of the Rocky Mountain goat. In a day one may penetrate a pathless forest or stand on craggy heights, where the view presents the jagged Rockies, the backbone of the continent.

PUBLICATIONS.

Articles from persons who have attended the Station or taken part in its work have appeared from time to time in such magazines and periodicals as The Journal of Applied Microscopy, The Nautilus, Science, The Condor, The Botanical Gazette, Journal of the New York Botanical Garden, etc. The bulletins issued by the University as a result of the work are: No. 1, "Summer Birds of Flathead Lake," P. M. Silloway, 84 pp., 16 plates; No. 2, Announcement of the Fourth Annual Session; No. 3, "A Biological Reconnaissance in the Vicinity of Flathead Lake," M. J. Elrod, 94 pp., 29 plates; No. 4, Announcement of the Fifth Annual Session; No. 5, "Lectures Delivered at the Station," 78 pp., 6 plates, 28 figures; No. 6, "Additional Notes to Summer Birds of Flathead Lake," P. M. Silloway, 32 pp., 5 plates; No. 7, "Lichens and Mosses of Montana," W. P. Harris and Carolyn W. Harris, 24 pp., 9 plates; No. 8, Sixth Annual Announcement; No. 9, Seventh Annual Announcement; No. 10, "The Butterflies of Montana," by Morton J. Elrod, assisted by Frances Inez Maley, B. A., pp. 1-174, with one colored and thirteen black and white plates and twenty-five figures; No. 11, A List of the Fishes of Montana, by James A. Henshall, 14 pp.

LIFE AT THE STATION.

There is a freedom of living which makes life pleasant for those attending. Out-door clothing is worn by all. A canvas suit with plenty of pockets is suitable for men, with a business suit for occasions. For mountain trips a suit of woolen underwear is desirable, and a sweater will come handy. For tramps in the woods, climbing mountains, or walking the rocky beach, a pair of heavy soled and hob-nailed shoes are a necessity. As most of the Station work is out of doors and of the rough and ready nature, good clothes are an encumbrance. The freedom from conventional dress makes Station life more helpful and desirable. A good bathing suit will be found serviceable.

BAGGAGE.

Avoid trunks. Pack outfits in rolls, covered by canvas, fastened by large and strong straps or ropes. Hand baggage of any kind is not troublesome. Heavy weight of books is unnecessary. For those who live in tents, as most persons prefer to do, a tent is necessary. This will make a small roll, and for ordinary miner's or wall tents poles are not necessary. They may be cut after arrival.

Those who sleep in tents must remember the nights are always cool. A cheap tick, ready to be filled, and two comforts or heavy blankets over, with whatever is desired under the individual, are necessary. These can be purchased after arrival, if this is desired, and at reasonable rate. In place of the preceding a sleeping bag is a luxury.

Reduce baggage to a minimum in weight. Heavy weight of books is not advisable, but reading matter for leisure moments should be brought.

Eastern students can visit the Station at very low expense. The Great Northern and Northern Pacific railroads have low rates to the west every summer. Stopover privileges can be secured giving plenty of time to spend at the Station. It is thus possible to spend a summer in the mountains, gather plenty of working material from a new field, at low expense. Such an opportunity to visit mountainous regions is offered at few places.

For any further information address,

MORTON J. ELROD, Director,
Missoula, Montana.

For information concerning the University, its departments, courses of study, etc., address,

OSCAR J. CRAIG, President,
Missoula, Montana.

Fig. 123. Camp at Stanton Lake.

Bulletin University of Montana No. 41
Biological Series No. 13.

NINTH ANNUAL ANNOUNCEMENT
OF THE
University of Montana Biological Station
At Flathead Lake, Bigfork, Montana

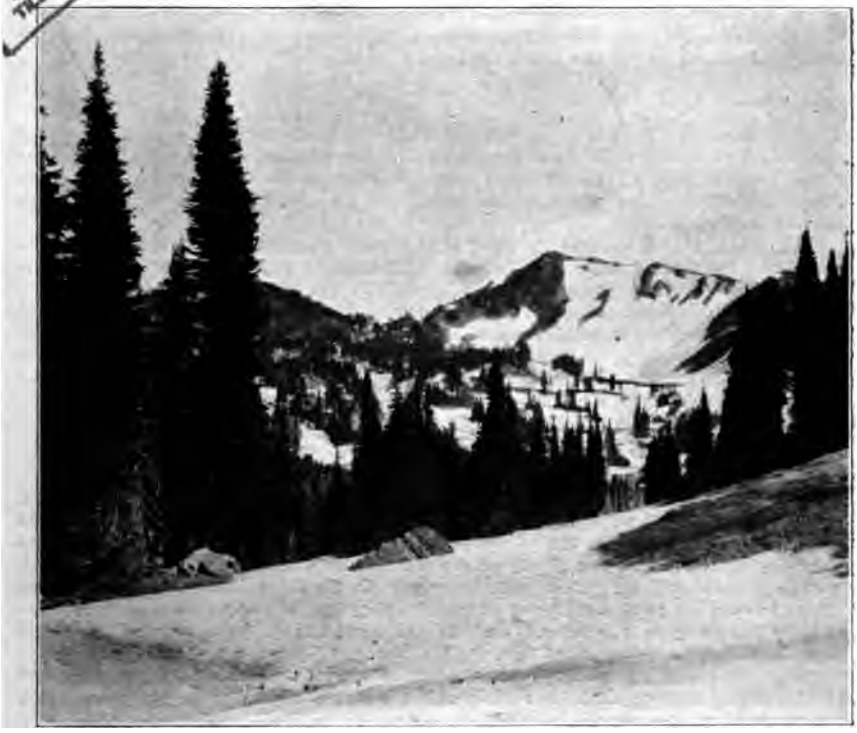

Fig. 124. MacDougal and Norton mountains, visited anuually. Around the snow banks are great beds of beautiful spring flowers.

NINTH SESSION, JULY 9 to AUGUST 15, 1907.

Oscar J. Craig, President, University of Montana, Lecturer.

Morton J. Elrod, Professor of Biology, University of Montana, General Zoology and Botany.

P. M. Silloway, Superintendent of Schools, Lewistown, Montana, Bird Study, The Forest.

Maurice Ricker, Principal, West Des Moines High School, Photography, Nature Study.

Mrs. Edith Ricker, Station Artist.

C. H. Scherf, Science, Flathead County High School, Physiography.

Entered August 24, 1901, at Missoula, Montana, as second class matter, under an Act of Congress, July 16, 1894.

PURPOSES OF THE STATION.

The University of Montana Biological Station, located at Bigfork, at the head of Flathead Lake, was designed to serve as a field for research work for the instructors and for others who may wish to attend; to afford opportunity to teachers to collect material for class use and for their own laboratories; to afford a place where teachers and students of biology may meet; to give opportunity for studying the biology of Flathead Lake; for giving instruction in biological subjects.

COURSES OF STUDY.

The following scheme will give those who wish to attend an idea of the kind and character of the work that may be done.

Zoology:—

(a) General Zoology, principally field work, instructions in methods of study and observation, illustrating the influence of environment. An observational study, full of suggestion, very helpful to those who have had no such opportunity for study. Material will be collected and worked up in the laboratory.

(b) Field and laboratory course in Entomology. Instruction in collecting, preserving and labelling insects. Dissection and study of type specimens. A study of injurious insects.

(c) Ichthyology. Special course devoted particularly to the lake and river fishes and their food supply. The course will include plankton study.

(d) Ornithology. A study of birds, with methods of collecting, making and preserving skins; habits and lives of birds of the rich avian region adjacent. Each student should be provided with field glass.

(e) Plankton. A study of the microscopic life of Flathead Lake.

Botany:—

(a) Laboratory and Field Course. Study of type forms of Algae, Fungi, Lichens, Bryophytes, Pteridophytes, and Spermatophytes. Especial attention will be given to the Conifers of the vicinity. There will also be collecting trips in the field, where the various type forms may be found. In the laboratory, attention will be given to the classification of the more common species, to the study of Plant Morphology, to the methods of preparation of Herbarium specimens, and to the methods of preservation in liquid for immediate or permanent use.

(b) Ecology. A general course including local ecological problems and local plant geography. This region offers quite a diversity in plant societies.

Photography:—

The region offers rare opportunities for this branch of study. The work will include a study of lenses, plates and developers. The use of the ray filter will be explained, and the many errors which may fall to the lot of the beginner will be pointed out. The course will include the selection of subject, development, printing one or two kinds of paper, and transparencies.

Students in photography must supply their own cameras and material. There is a dark room at the laboratory and the scenery in the vicinity gives ample scope for a series of negatives either in landscape or of scientific subjects.

Nature Study:—

A course of study and practical work will be outlined which will afford both a fund of information on which to draw during school work and at the same time secure a collection of material to be used in illustration. The scope of the work will include zoology, botany, geology, and physiography of the region.

Physiography:—

Largely field work. The region furnishes examples of all of the important types of erosion, weathering, ice work, running water, shore work, etc. An attempt will be made to trace the history of a stream, the effects of glaciation on a region, the method of mountain formation, results of sedimentation, and coast forms. Some reading will be done in the field. Besides this there will be offered a series of illustrated lectures covering the important topics in physiography. The slides will represent types selected from all parts of the world. This course should be of particular interest to those who teach physical geography, either in the high school or in the grades.

Research Work:—

Students who desire to do so may, if qualified, enter upon the study of some faunal, ecological, or other problem, and will be afforded every facility of the station.

The above courses are outlined for those who may attend, to indicate the work that may be pursued. Several points of Flathead Lake will be visited, possibly a week being spent at each place, to which plan the above courses will be accommodated. Those attending will thus be assured of excellent opportunity for out-door study by this plan.

LOCATION.

The University of Montana Biological Station was opened in 1899. For the past eight summers the station has been occupied from June until September or October. During this time some fifteen states have been represented. The Station has become well known to many American naturalists, and all are enthusiastic in their praise of opportunities afforded in the vicinity of Montana's large inland lake.

For scenery the vicinity cannot be surpassed. Few places offer more varied points of interest. The roaring rapids of Swan river are at the door of the building. Flathead lake, covering more than 300 square miles of territory, with its beautiful islands and precipitous shores, has great attractions. The Mission range, beginning on the burnt hills by the laboratory, and rising higher and higher as they extend southward, culminate in snow-capped peaks 10,000 feet in height. A few miles to the east is the Swan range, its high summits constantly in view. These two mountain ranges afford some of the most beautiful panoramas to be seen in the Rocky Mountains, and rival the Alps in magnificent scenery. Farther to the east, reached in a short time by pack train, the main chain of the Rocky Mountains breaks the horizon with lofty peaks and precipitous summits. Untrod summits invite the courageous naturalist who seeks the unknown animal and vegetable life. West of Flathead lake are the almost unexplored Cabinets. Within a few miles are many lakes—Swan, Echo, Rost, and others—while many ponds and swamps are in the immediate vicinity. The waters of Swan and Flathead rivers supply Flathead lake, the former at the laboratory door, the latter but two miles distant. East and south of the laboratory the forests extend unbroken for a hundred miles, with here and there a settler's cabin. Such a combination of lakes, rivers, mountains, forests, at elevations from 3,000 to 10,000 feet, one will find in few places in America.

The present site of the Station was chosen because of the advantages mentioned above. The seaside will always have its attractions and its devotees. But there are those who love the mountains, who delight in craggy heights, and who find abundance of material for study because it is new and the field unexplored. There are many who cannot take long trips to the sea shore, others who wish to spend a summer on the inland lakes, in the primeval forest, and among the snow-clad hills. Then there is the home field. Montana needs a wider dissemination of knowledge of outdoor study. Here may be had healthful recreation, beautiful surroundings, congenial associates, and rare opportunities for observation and study.

The climate is delightful. Rarely does it rain in July and August. In the shade it is always pleasant. Long trips may be planned without danger from the elements. One may sleep out without fear. In a day from the laboratory one may reach huge snow banks in middle August. There is an abundance of sunshine, no fogs nor dreary days, and few days of excessive heat.

EQUIPMENT.

The building is a convenient out-door laboratory, with tables for a dozen students. The station work has entirely outgrown the building. Many of the lectures are given out of doors in the yard. The fine summer weather permits of much laboratory work out of doors. There is a dark room for photography. The laboratory has a 16-foot gasoline boat with three horse power engine. This is at the service of those attending the station, and with it various portions of Flathead Lake and Flathead River are easily accessible.

Fig. 125. Hunting things in the woods near Swan Lake, on the trail. Such trails are the only roads through hundreds of miles of forest.

There is a row-boat, and canvas boat for the mountain lakes, property of the Station. Other boats may be had at any time. Microscopes, glassware, books and utensils will be supplied from the University. Botanical collecting and drying material will be supplied.

Students in Ornithology must supply their own guns or field glasses. Students in Photography will furnish their own cameras and plates. The necessary chemicals for development will be supplied free. Students who live in tents will supply their own tents and bedding.

UNIVERSITY CREDITS.

Students from the University may pursue study at the Station and receive credit for such work as may be equivalent to University courses. Students taking elementary study may receive preparatory credits.

METHODS OF INSTRUCTION.

The work will consist very largely of field collecting and observation, study of relation to environment, supplemented by laboratory dissections and microscopic examination. The general courses will enable teachers to familiarize themselves with methods of field work, and the manipulation of laboratory material.

The expeditions are primarily to give opportunity for the study of animals and plants in their natural environment. By this means more lasting interest is aroused, and more accurate information is obtained.

LECTURES.

Occasional lectures of a general nature are given by the Station staff. To these the public is invited. Some of these have been printed by the University as a bulletin. Many of them are illustrated with stereopticon.

Fig. 126. Resting in the woods, on the way up the mountain. Note the luxuriance of the forest.

EXCURSIONS.

Collecting excursions to more remote places are taken weekly. During past years excursions have been taken to Swan Lake, eight miles distant and twelve miles long; camp was made at the upper end; to Rost Lake, in the forest at the base of the Swan range; to the summit of MacDougal Peak, over an Indian trail, to altitude 7700 feet, in the realm of perennial snow; to various portions of Flathead Lake. After the Station work is over a pack horse trip into the deep mountains has been annually undertaken, a small party of a half dozen or so making a collecting and exploring trip.

These trips will be under the personal supervision of the Director of the Station. Those taking the trips must bear a proportionate share of the expense necessary. Such trips will prove of great value and interest biolog-

Fig. [illegible] [illegible] Lake. Photograph shows the beautiful paperbirch trees on the shore. Photo by M. J. E.

ically aside from the pleasures they bring. These trips are not for mere pleasure, but for scientific study. Daily conferences are held to report on observations and to make suggestions.

HOW TO REACH THE STATION.

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Students via Great Northern will get off at Kalispell, connecting by stage with the steamer Klondyke at Demersville, a short distance from Kalispell. The steamer will land passengers at Bigfork.

The trip either way is full of interest. No one should hesitate because they must ride in a stage. The ride from Ravalli is comfortable, the scenery along the way beautiful. The ride from Kalispell is on the winding Flathead river for 30 miles, with charming views at every turn. There are very good hotel accommodations. Every mile of either route is attractive in its surroundings.

Since writing the above an automobile stage has been put on between Ravalli, on the railroad, and Polson, at the foot of Flathead Lake. The trip of 35 miles is made in less than three hours, and the journey made exceptionally easy.

DATE OF OPENING

The laboratory work of the Station will begin Tuesday, July 9, and continue more than five weeks, or until Thursday, August 15. For a week or more before the Station opens some one of the staff will be at or near the Station, and will aid any who may choose to work during such time. The laboratory is at the disposal of students from June 15 to September 1, or even later, if any wish to use it.

BOARD AND ROOM.

Those who desire it may board and room at the hotel at Bigfork. Accommodations may be had at $6.00 per week, board and room, with two in a room, or $7.00 per week with one in a room. Nearly all live in tents and take meals at the hotel. Good day board is furnished at $5.00 per week. Fine weather during July and August makes camping a delight, and tent life is a pleasure. When the collecting trips are taken tents are usually used, as also bedding, making tent life specially desirable. There are no places where board may be secured on trips, and the party must make provision for its own comfort. For those who wish to do their own cooking the stores furnish all the necessaries of life, while the surrounding country supplies an abundance of fruit and vegetables.

RECREATION.

Change is rest. To take a day off and go fishing often gives new lease of life. The tingle of the nerves when the gamey fish tugs at the line is to forget care and to be thoroughly alive. One of the attractions of the place is its natural advantages so as to induce out-door exercise and study. The lake and rivers make rowing a good pastime. The photographer has a field of wondrous richness and varied interest. A fine sand beach makes bathing a delight, and it is indulged in. Unless the lake is stirred by winds the water is warm. The hills and forests afford quiet retreats for study or strolls. The hills and roads give glimpses of scenery of rare beauty. At the proper season hunting is good. Deer have been seen annually a few rods from the laboratory. Grouse and pheasants abound in the hills. In season duck shooting is fine. A day's tramp will take one to the home of the Rocky Mountain goat. In a day one may penetrate a pathless forest or stand on craggy heights, where the view presents the jagged Rockies, the backbone of the continent.

BAGGAGE.

Avoid trunks. Pack outfits in rolls, covered by canvas, fastened by large and strong straps or ropes. Hand baggage of any kind is not troublesome. Heavy weight of books is unnecessary. For those who live in tents, as most persons prefer to do, a tent is necessary. This will make a small roll, and for ordinary miner's or wall tents poles are not necessary. They may be cut after arrival.

Fig. 128. The region about the laboratory is rich in material for study.

Those who sleep in tents must remember the nights are always cool. A cheap tick, ready to be filled, and two comforts or heavy blankets over, with whatever is desired under the individual, are necessary. In place of the preceding a sleeping bag is a luxury.

PUBLICATIONS.

The number of publications, based wholly or in part on the work carried on at the laboratory, is considerable. Many are in course of preparation. They cover principally the material in the vicinity. The birds have been listed, and much new information derived on their habits and distribution. The work on butterflies was expanded into a bulletin covering the entire state. The lichens and mosses have been listed, and many papers written on the forestry and botany of the region.

LIFE AT THE STATION.

Some people want a vacation with nothing to do but lie around in a hammock and let some one else get the meals and tote the luggage. They wish for nothing that will stir the blood or the nerves. Such a vacation is of little use. One can have more fun with a definite object in view than with no object sought. Change, not inactivity, is rest for the normal individual. This latter is the keynote to the Station work. There are woods for strolls, mountains for climbs, lakes for rides, rivers for fishing, forests for hunting, and fine views for sketching. Every trip brings something of health, pleasure, and profit. Attention to some object to be attained centers the mind upon things other than the body, and weariness and fatigue are forgotten in the pleasure of new pursuits.

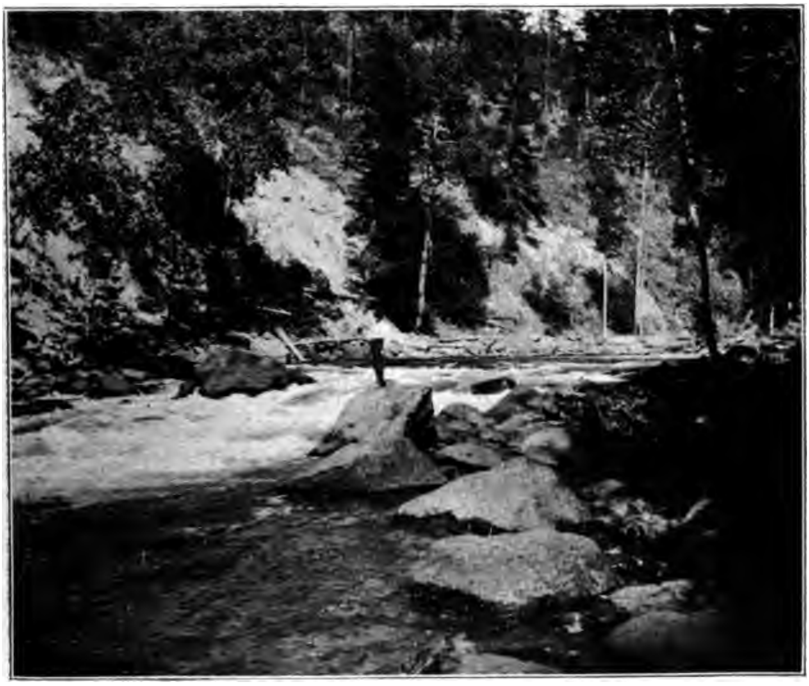

Fig. 129. Swan River as it flows in front of the laboratory. The sound of the rushing river is constant music to our ears. Photo by Ricker.

Camping is an art. Those who have not camped have missed a great deal—much more than they suspect. The knack of taking care of one's self under trying circumstances of camp life does not desert one in the everyday business of life.

Those attending the Station are offered the following good things:

A chance to study under favorable circumstances, with most helpful conditions and enthusiastic companions.

A delightful camp in a fine climate and a beautiful location.

Views of grand scenery of varied character.

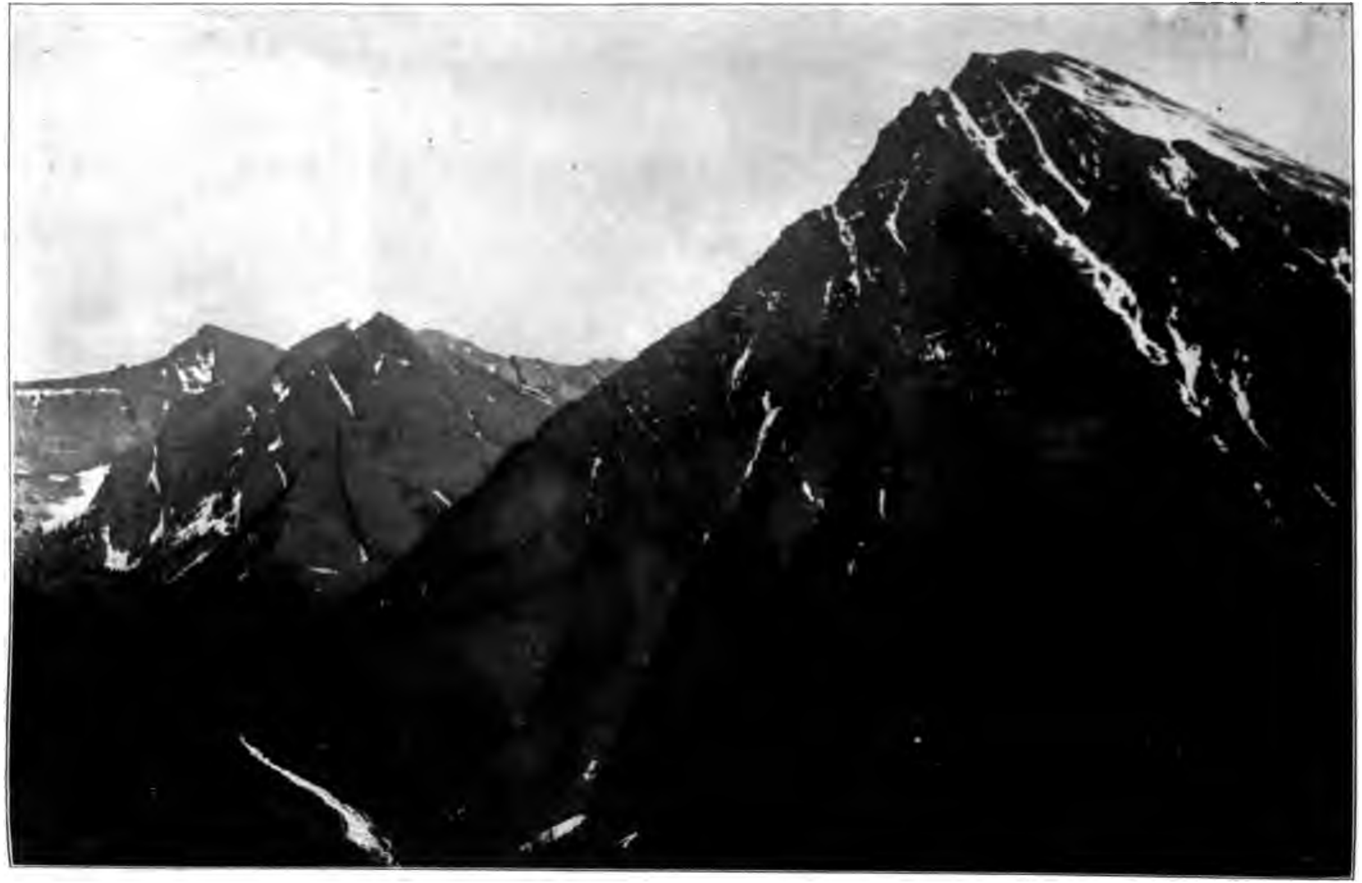

Fig. 130. Mission Mountains, near St. Ignatius, showing alpine scenery in June.

Recreation that is healthful, invigorating, accentuated by freedom from restraint and conventionality.

There are no laboratory dues or fees of any kind, save necessary expenses for board and for trips.

Those who have no knowledge of the subjects presented are as welcome as advanced students.

For any further information address,
MORTON J. ELROD, Director,
Missoula, Montana.

For information concerning the University, its departments, courses of study, etc., address,
OSCAR J. CRAIG, President,
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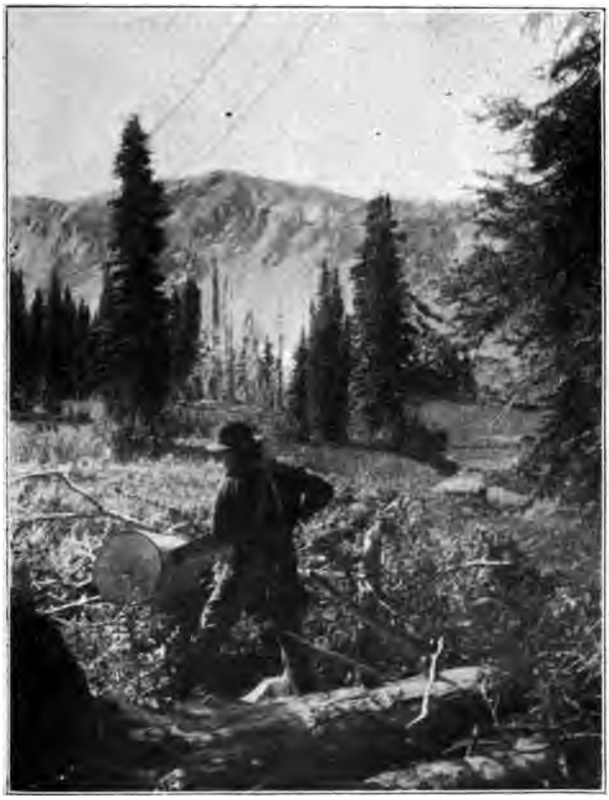

Fig. 131. Taking sections of alpine fir for museum collections. Sections were carried down the mountain on a pack horse.

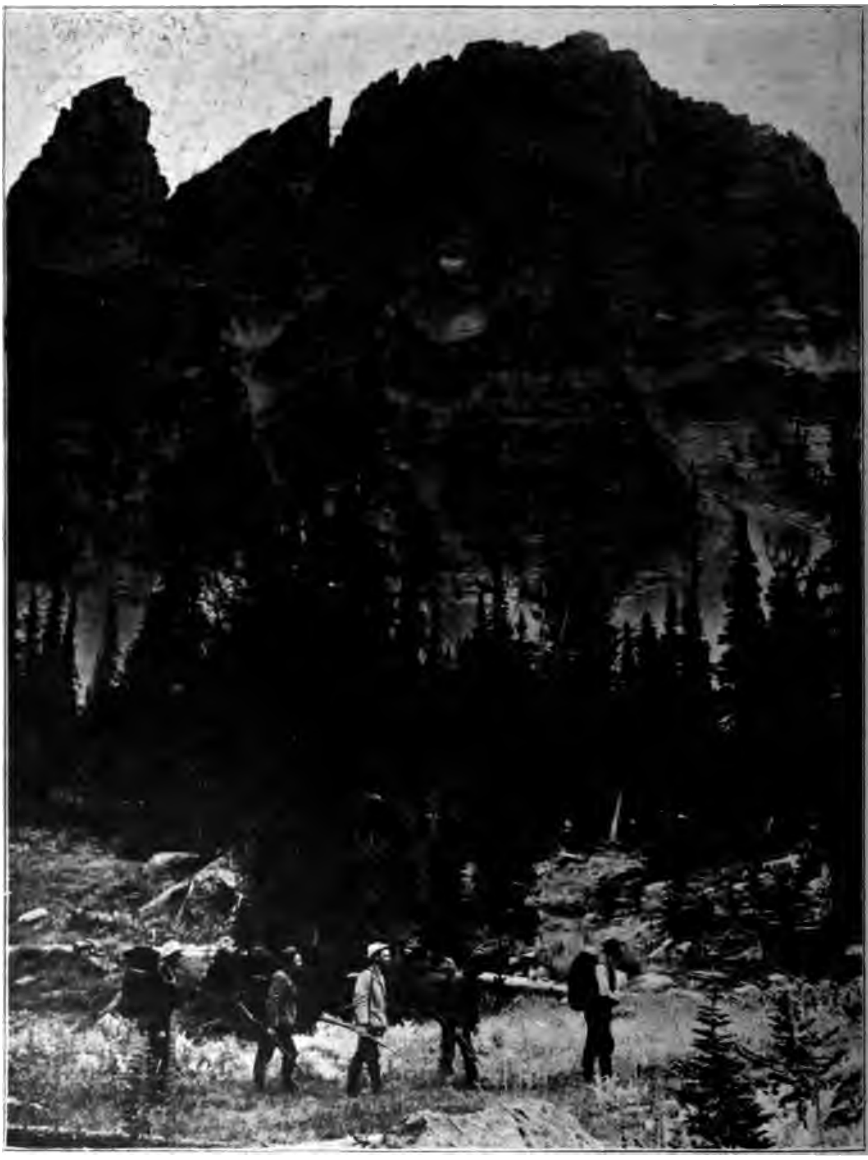

Fig. 132. A party from the station at the foot of the cliffs, 2700 feet high, on Mt. St. Nicholas, in the main range of the Rockies. Note the beautiful trees, alpine fir and alpine pine. Note also mode of packing. Photo by M. J. E.

BULLETIN UNIVERSITY OF MONTANA, No. 46
BIOLOGICAL SERIES No. 14

PICTURED ROCKS

INDIAN WRITINGS
ON THE
ROCK CLIFFS OF FLATHEAD LAKE, MONTANA

By
Morton John Elrod, Ph.D.,
Professor of Biology, University of Montana,
Director, University of Montana Biological Station.

UNIVERSITY OF MONTANA, MISSOULA, MONTANA, U.S.A.
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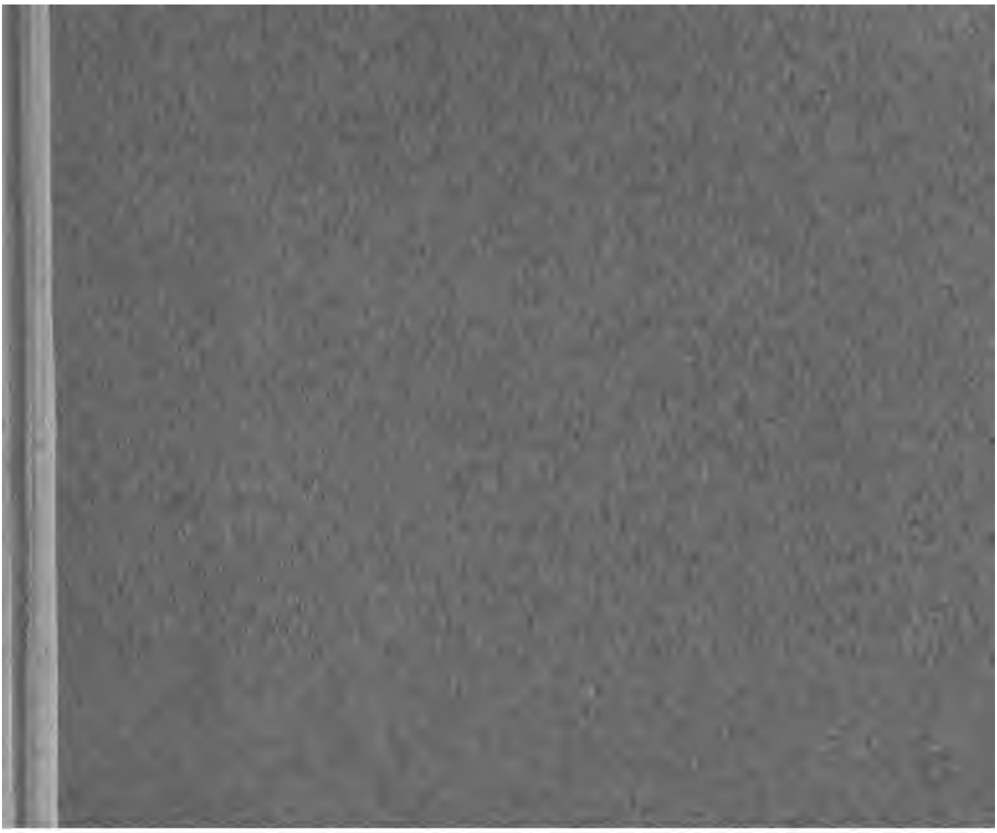
Entered August 24, 1901, at Missoula, Mont., as second class matter, under act of Congress July 16, 1894



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Press of
THE DAILY MISSOULIAN
MISSOULA, MONTANA

TRAVELERS across Flathead lake by boat usually have their attention called to the "Pictured Rocks," on Angel Point, on the west side. Especially is this true when the boat puts into bay to the west, around or back of Wild Horse Island, for Dayton. On the way out as the boat rounds the point and steams out into the open lake the passage is close to the cliff on the shore, and the hieroglyphics are plainly seen by the passengers with the naked eye.

The cliff on which the writings occur is not in the Flathead Indian Reservation but about two and a half miles northeast of the place where the north reservation line cuts the west shore of the lake, in township 25 north, range 20 west, section 22. They may be easily approached from either side along the shore, the shelf or shore being narrowest at the cliff where the writings occur. Here there is barely room to walk along the shelf at the foot of the rocks, and one could step from the narrow shelf into the lake at high water. A few rods to the north is the house of a settler, but the country about is wild and unbroken.

The pictured rocks make up a cliff rising almost vertically from the clear waters of the lake. Along the face of the cliff, about waist high from the shelf on which one stands on leaving the boat, and as high as a man can reach, is the splendid series of Indian writings. It is the purpose of this paper to give briefly such information about these writings as is at present available, together with photographs taken by the writer.

Flathead Lake is in the northwestern part of Montana, and receives the drainage from almost the entire northwestern section of the state. It extends north and south, with a length of about thirty miles. At its widest portion east and west, it is almost twenty miles across. Its eastern shore is flanked by the Mission mountains, which come down quite abruptly to the water's edge. On the western shore the mountains are not so abrupt, leaving small tracts of tillable land between the lake and the steep mountain faces, although the mountains really begin at the water as on the eastern shore. The upper end is a broad and fertile valley, the old lake bed. At the lower end there is a morainal hill some 450 feet high, separating the lake shore from the beautiful Mission valley. More detailed information is given in the Bulletins University of Montana, "A Biological Reconnoissance in the Vicinity of Flathead Lake," with many plates, and "Lectures at Flathead Lake," pages 197-203, with illustrations, both by the writer.

Several spurs from the Cabinet mountains drop down to the waters of the lake on the west. One of these is Angel Hill, ending at Angel Point on the lake. As before stated, the cliff of this hill, where it ends at the lake, contains the Indian writings. By referring to Fig. 1 the exact location of these rocks may be determined.

The map is inaccurate in one respect. Between the "Pictured Rocks" and Wild Horse Island, a short distance from shore, and not much farther from Wild Horse, are two small islands. These are unnamed, and for convenience

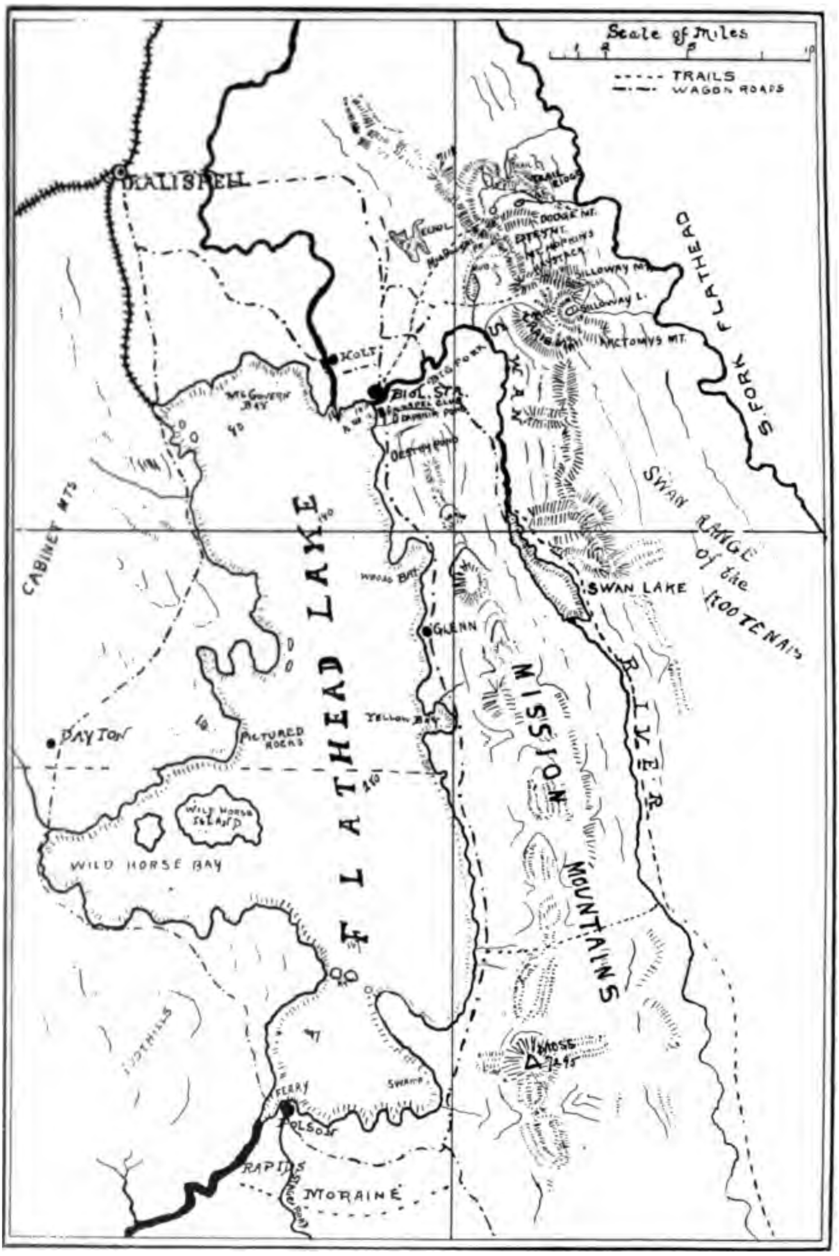

Fig. 1. Map of Flathead Lake, showing the location of the pictured rocks. See also Fig. 2.

will be called Twin Islands. One of these, possibly both by this time, was at time of our visit occupied by an enterprising homesteader.

The cliff comes down abruptly to the water at Angel Point. A few large boulders have tumbled off into the water, and above the lake's level in middle or late summer is a sort of shelf between the lake and the cliff, a few feet above the water. One may by this means get close up to the writings, and for that matter touch them all. Plate III shows the relation of the cliff to the water, and the scant room at the foot of the cliff.

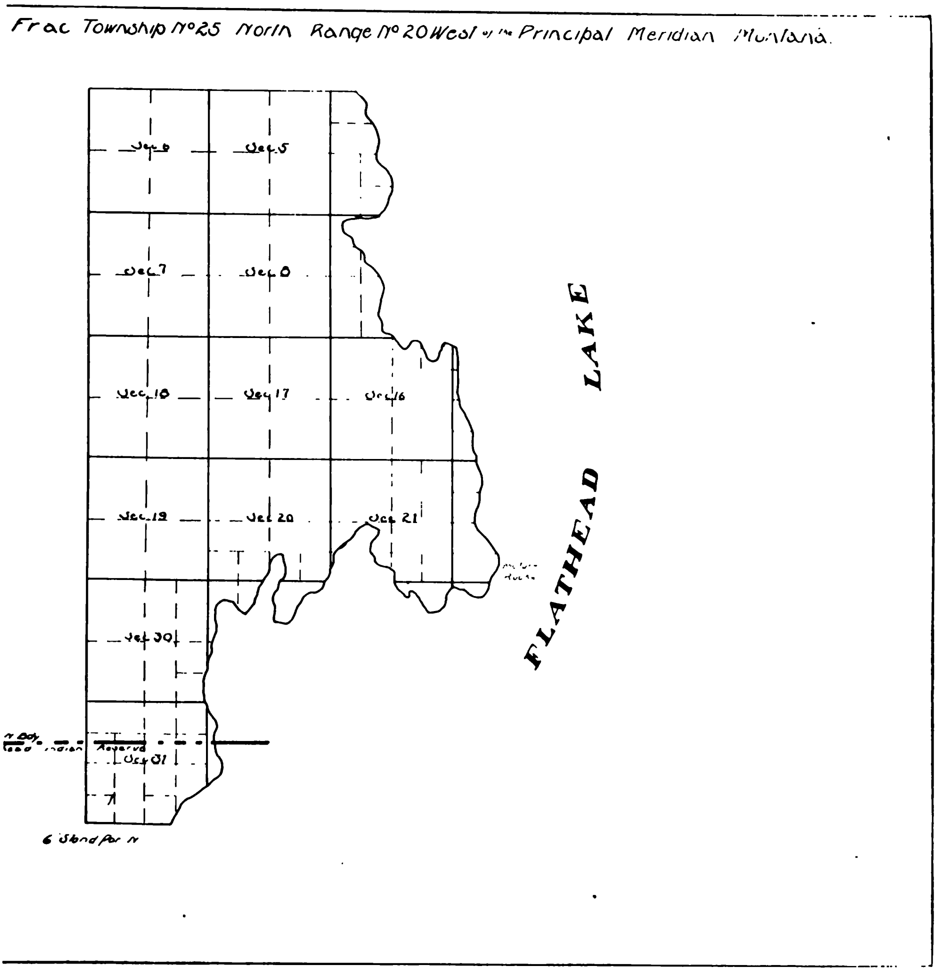

Fig. 2. A portion of the shore line, reduced, from official survey, showing the location of the rock cliff on the lake shore. Compare with Fig. 2.

The water at this point is clear and deep. The following soundings taken August 14, 1904, show how deep the cliff extends below the surface:

Off point of "Pictured Rocks:"

50 yards off shore, 157 feet.
300 yards off shore eastward, 160 feet.
600 yards off shore, 170 feet.
Three-quarters of a mile southeast, 175 feet.
One mile southeast, 157 feet.
One and one-fourth miles southeast, 148 feet.
Half way between Wild Horse and Twin Islands, 158 feet.

The soundings were made by Maurice Ricker, now principal of the West Des Moines High School, with our specially constructed apparatus, a line with plumb bob, the line running between the wheels of a wire measuring apparatus. The soundings show that the comparatively level lake bottom extends to within a few feet of shore, and that the cliff rises abruptly from the lake bottom.

Landing at the point is not generally to be accomplished. The westerly winds from the low pass at the former lake outlet to the west usually blow eastward across the arm at Wild Horse bay. A wind usually blows up or down the lake. The currents meet off Angel Point, and the wind may blow from "any direction." There is no beach at the point, and boats of any kind, large or small, would soon be badly pounded on the sharp rocks.

On our visit in 1904 we had very fine weather and still water. The small steamer Bigfork touched easily among the sharp edges, for the lake was smooth as glass. We landed first on the evening of August 13, and returned the next day to spend some time. Prof. J. M. Hamilton, now President of the Montana College of Agriculture and Mechanic Arts, and the writer devoted attention to the writings while Mr. Ricker made the soundings. Our party was camped at Wild Horse Island.

Professor J. P. Rowe, of the University, gives the composition of the rock composing the cliff as follows:

The cliff is of quartzite shale, and probably belongs to the Burke formation, or at least Pre-Cambrian. The hardness of this rock is between 5 and 7, and withstands the weathering well. The walls would remain perpendicular for a long time, regardless of the agencies of disentegration. It is almost devoid of rifts and joints, and in many places where found makes perpendicular cliffs.

A few portions of the rock with the writings were broken off and brought to the University for study. W. D. Harkins, Professor of Chemistry in the University, examined the material used for making the hieroglyphics. He reports it as being oxide of iron.

The difference between the material used by the Indians in making these writings and ordinary paint is apparent at once when comparison is made. The Indian writings show up well in all photographs that have been taken. On the cliff at the southern or left hand end of the writings, some one had drawn the figure of a horse, some three feet long. It was a crude affair, clumsily executed with a brush an inch broad, made with a peculiar gray-brown paint. The photograph of the rock wall containing this picture, taken in the same manner as the others shows nothing of the picture on the plate. It is a clear blank so far as the horse is concerned, although the cliffs show as well as in the other pictures.

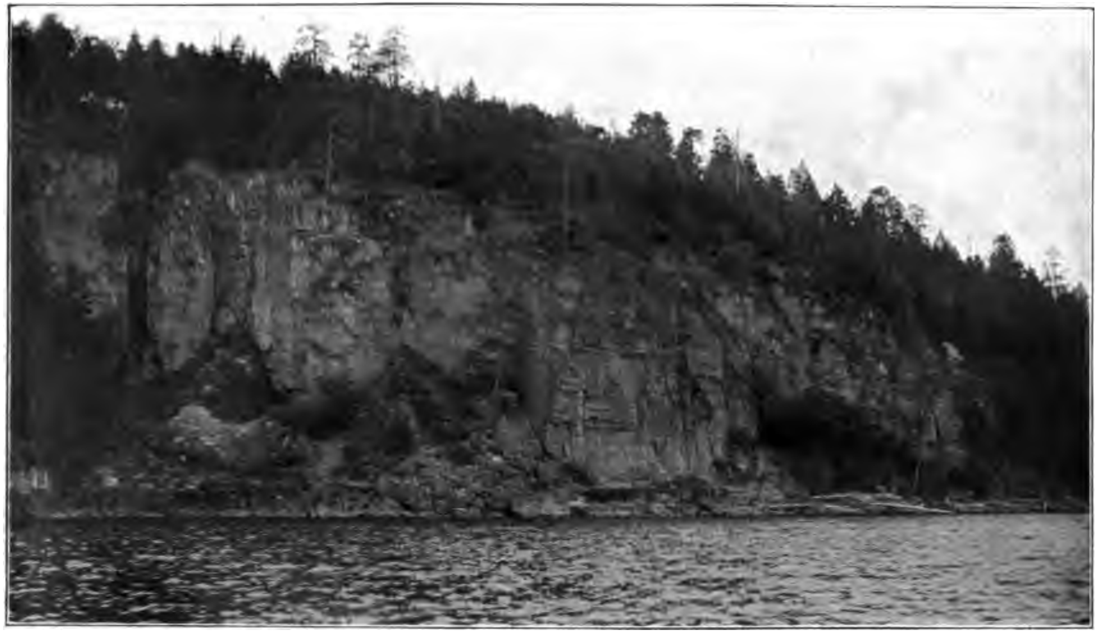

Fig. 3. General view of the cliff on which the writings occur, taken a short distance off shore.

The rocks at the point form an angle, on both sides of which the writings occur. To secure suitable photographs of the whole series of figures on one plate is impossible. It is too far away to take photographs from the boat, and too low down. There is not room on shore. The writings must therefore be presented in a broken series, each picture representing a portion of the figures. Plate II gives a fair idea of the cliff and the writings, and in this a large number of the writings may be seen

The total distance used on the face of the rock is about 35 feet; counting the curves and angles, about 10 feet more. The highest point above the floor of the rock is at the southern end of the writings, about 12 feet. For the most part the height is about as great as a man could reach, and from that down to the crumbling floor.

Apparently but little rock has fallen from the face of the cliff since the markings were made. The shelf or floor in front of the cliff on which the writings occur is from 5 to 10 feet wide, for the most part filled up, with barely room to stand. As it is quite sloping there is no chance to photograph from so close quarters. The shelf has grass and other vegetation growing on it. A few yards from the writings a beautiful syringa bush is growing, on either side, lending a charm to the view, and showing in striking contrast.

The writings were visited in August of 1907, and showed no noticeable change from that condition noticed in previous years. The water in the lake was a little higher on the rocks, the water a few feet deeper. But this varies much, from year to year and from spring to fall.

The writings themselves have many peculiar and interesting features. There are over 200 different and distinct marks or markings. As many as 15 distinct animals are shown; five of these are of buffalo, as shown by the humps on the back and by the shape of the body; one represents a deer, two have antlers of a moose and six are doubtful, mutilated more or less. There are 11 blotches, whose intent or meaning cannot be determined. There are 200 or more straight marks, some singly but mostly in groups. Some of the marks are very broad, as much as several inches. The last ones are undoubtedly made with the fingers and thumb, in groups of five, as though the hand were dipped into the writing material and then drawn down the face of the rock with fingers and thumb spread. It appears as though the writer got tired of making marks so accurately as would be indicated at first, and daubed it on in a hurry. The earlier or first markings were apparently made with much care, and are the highest on the rocks. Those at the right hand end are not so carefully drawn, and are all within reach.

The drawings seem to read from left to right. All the animals have their heads toward the left, their tails toward the right. The straight marks are vertical, or nearly so, on the rocks.

At the upper left end of the writings is perhaps the best series, certainly the best series of animals. First are two large ovals with an upward projecting appendage on the left side and two long lines extending downward. Within and without these lines are shorter lines, 14 in number, evidently representing the chronicling of important events. Below these are five large spots, two broken lines, and a broken figure of an animal. To the right of the ovals and of the broken lines just mentioned are six animals. Five of these I take to represent buffaloes or bison, the sixth a deer. There is a blotch of color which seems shapeless near the broken animal. Still lower is an animal with broad horns or big ears, whichever is intended to be represented, and with a broad and upturned tail. The legs of this figure are broader than those in the other figures. This is plainly shown in Plate II. I take it to be a moose.

Below this last figure and to the left is a blotch, probably representing an animal like the one described. Immediately below this is the figure of a deer (?) with a slender neck and long legs. Below this is a series of some 30 broad marks, in a fairly straight horizontal line, alike except for a large, broad Y, the fifth mark from the left hand end. Below all, close to the broken bottom of the cliff, and just above the shelf on which the artist evidently stood, are three broad and bold marks.

In the central portion of this group of figures and lines is a very large letter T, the stem of the letter being broken by a rift in the rock, in Plate II showing as a horizontal line. Around this are several large blotches, the remnants of figures or lines. To the right of the stem of the letter T is a series of lines which might be construed as representing a house, but which evidently do not. This is shown in Plate II.

The preceding figures are on the first mass of rock, extending to the angle of the cliff, the angle being intensified in the picture by a black line. In this plate the other writings are not plain. It is necessary to move to the right, take a new point of view, and observe those figures and marks on the other face of the angle. The angle in the rocks is shown well in Plates V and VI, as well as the additional markings which are to be briefly mentioned.

In Plates V and VI may be seen the angle of the rock where the figures just described are to be seen. In this broken edge are many straight lines, showing that the rock cliff has not disintegrated since the writings were made. For the next fifteen feet the rock face is somewhat irregular and broken. First along the angle mentioned in the preceding, about as high as one's head, is a row of nine straight lines. Below this several feet is a row of 14, and a little lower two pairs of short lines; still lower are eight large, broad marks, two lone lines at the bottom. This is a total of 37 lines, large and small, in the angle of the rock.

To the right is a peculiarly made symbol, consisting of five arms from a small central body, three pointing down and two up. To the right of this is an animal, quite well executed, similar to one previously mentioned. It has a long head, blunt and broad horns, an upturned tail, short, and stocky legs. It was probably intended for a moose. There are 8 lines and a blotch below the animal. To the right is a large blotch, several times as large as the animal. Then comes another break or angle in the rock wall, and to the right are still other figures. By consulting Plates VI, VII and VIII, and especially Fig 4, the number and location of the figures or characters may easily be seen.

First in height are three very broad and large—not long—lines. Below these are five long lines joined by a bar at the top, then four to the right, then eleven of varying size ending at another rock angle. Below there are on the left three broad lines running vertical; then a diagonal figure, large, consisting of a central body which is long and quite broad, broader than any line, two short projections upward from the middle, four from below, a short, a long, a short, a very long one. Below this figure are ten vertical lines; to the right are seven and a figure. The figure is a rude oval, the left portion filled with paint, and with three lines projecting upward. This is plainly shown in Plate VII, which also shows the peculiar irregularity of the rock. The angle on the right of the writings is easily seen in the picture. Consult also Fig. 4.

Turning the angle again on a further portion of the rock to the right, the highest writings are four vertical lines; below these two rows of lines. The first row contains six, joined at the top by a bar, then six separate lines; the second is similar to the first, with seven lines joined by a bar, followed by seven which are not thus joined. Just below these to the right is a figure which looks like an animal falling with its legs uppermost, only it has five legs, and it is headless. These are well shown in Plate VIII.

Then comes another small turn in the rock and the last group of figures. These consist of some 30 or more straight lines, laid on in a hurry, evidently with the broad hand, on a surface with plenty of room. The last figure is the most peculiar of all. It is shown in Plate IV, to the right of the figure of a man, in Plate VI, extreme right, and Plate VII. There are two moons, below which is a figure which apparently resembles a pack horse, but probably does not. If it represents a pack horse the writings are more recent than if it does not.

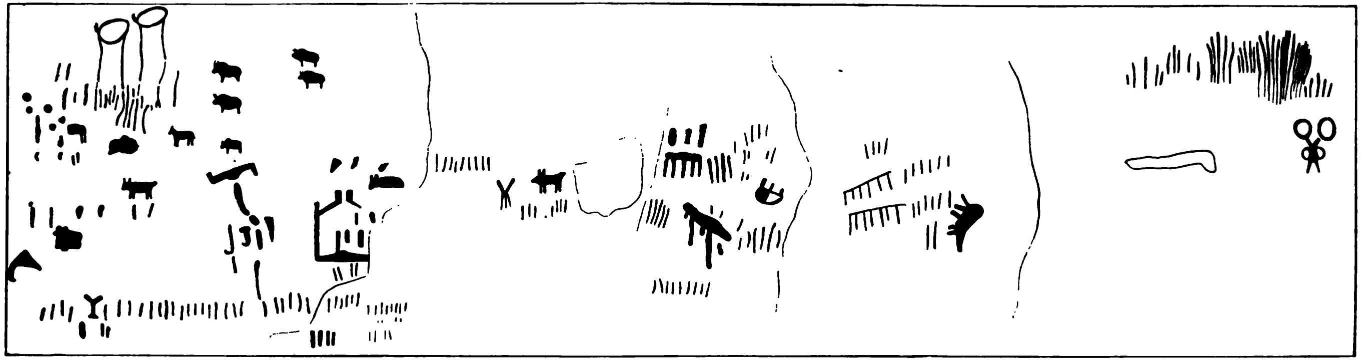

Fig. 4. Drawings of the different figures and lines, to show their respective locations. The angles in the rock face are shown by lines. The figures are not proportionate in size; the drawings show location and appearance only.

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DESCRIPTION OF PLATES

PLATE I.—The cliffs on which the writings occur, looking up the lake, north. The writings are within the lines drawn across the picture.

PLATE II.—This plate shows the left hand end, the beginning, of the Indian writings, showing the largest series of animals. The topmost portion of the writings on the left are not shown. Compare with Fig. 4.

PLATE III.—The cliff on which the Indian writings occur, looking down the lake, south. The writings are within the lines on the picture.

PLATE IV.—General view of the cliff and writings, showing them very much reduced. Owing to the curvature of the rock, the left end is somewhat out of focus. Compare with Plate V.

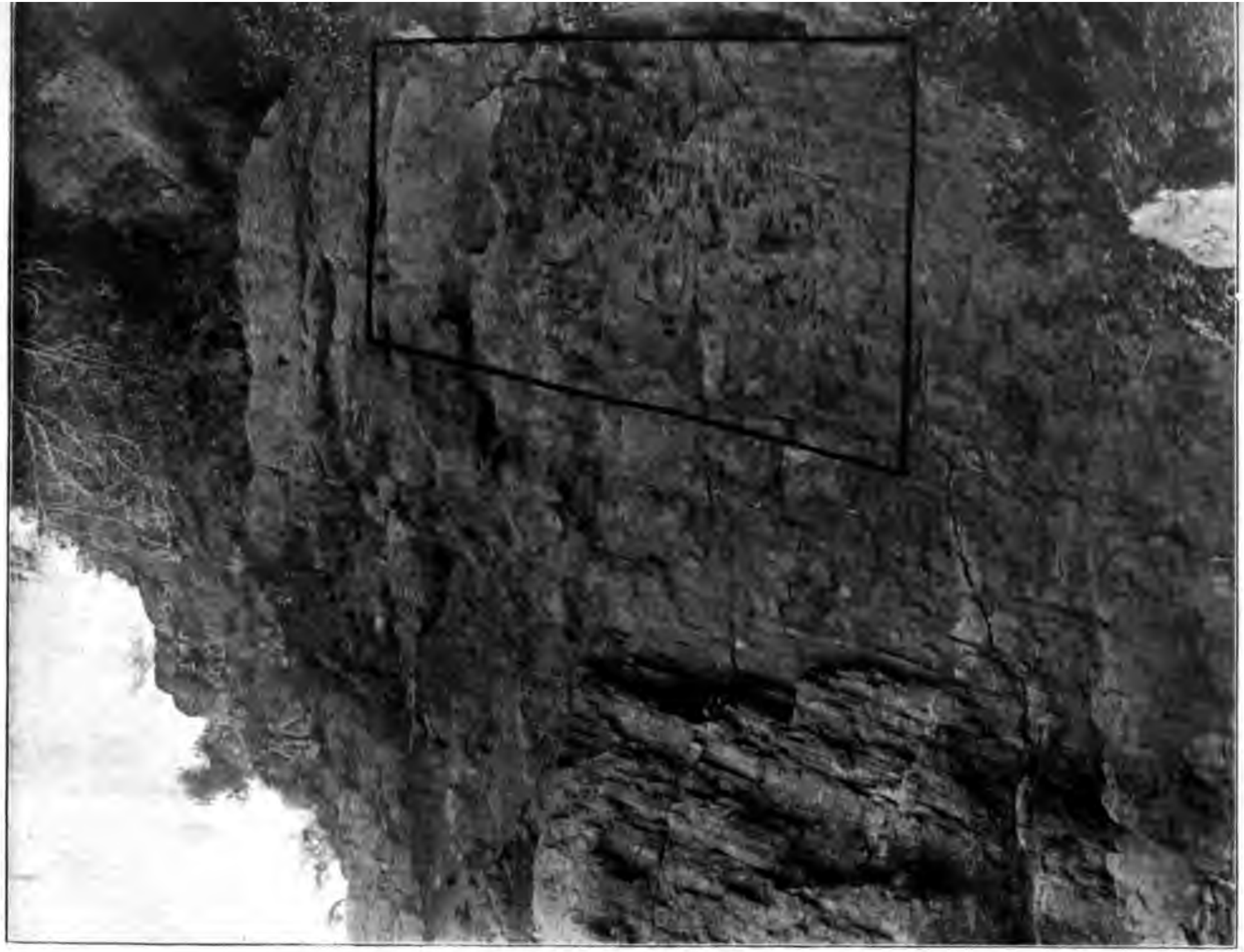
PLATE V.—This shows the character of the rock face, the broken angles, and the irregularities in the surface on which the writings are traced.

PLATE VI.—This plate shows the entire rock face from the edge of the water. Notice the shelf just below the writings, and the irregularities of the rock face.

PLATE VII.—This plate shows the right hand end of the writings, where some of the most peculiar and interesting figures are to be seen.

PLATE VIII.—The central portion of the writings is here shown, at one of the angles in the rock face. Note the crumbling under the writings, where the rock is softer.

PLATE IX.—By referring to Fig. 4 or Plate II, the portion of the rock face shown in this plate may be seen. It contains some of the largest marks and one of the unknown figures.



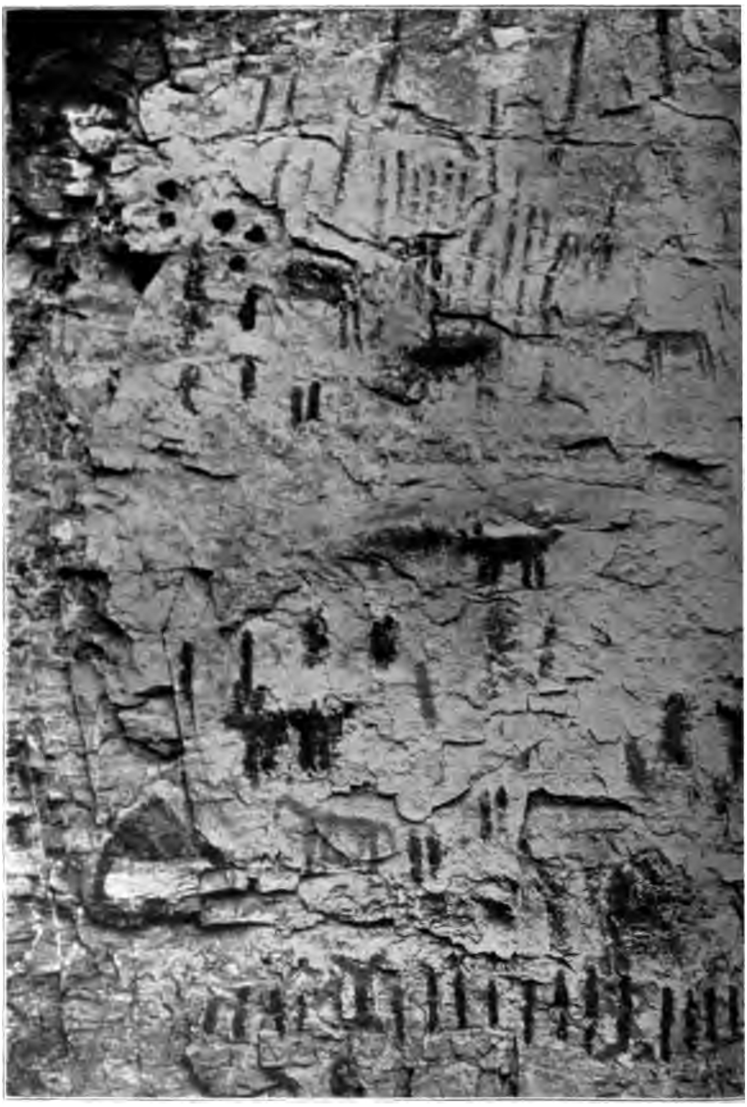


PLATE II

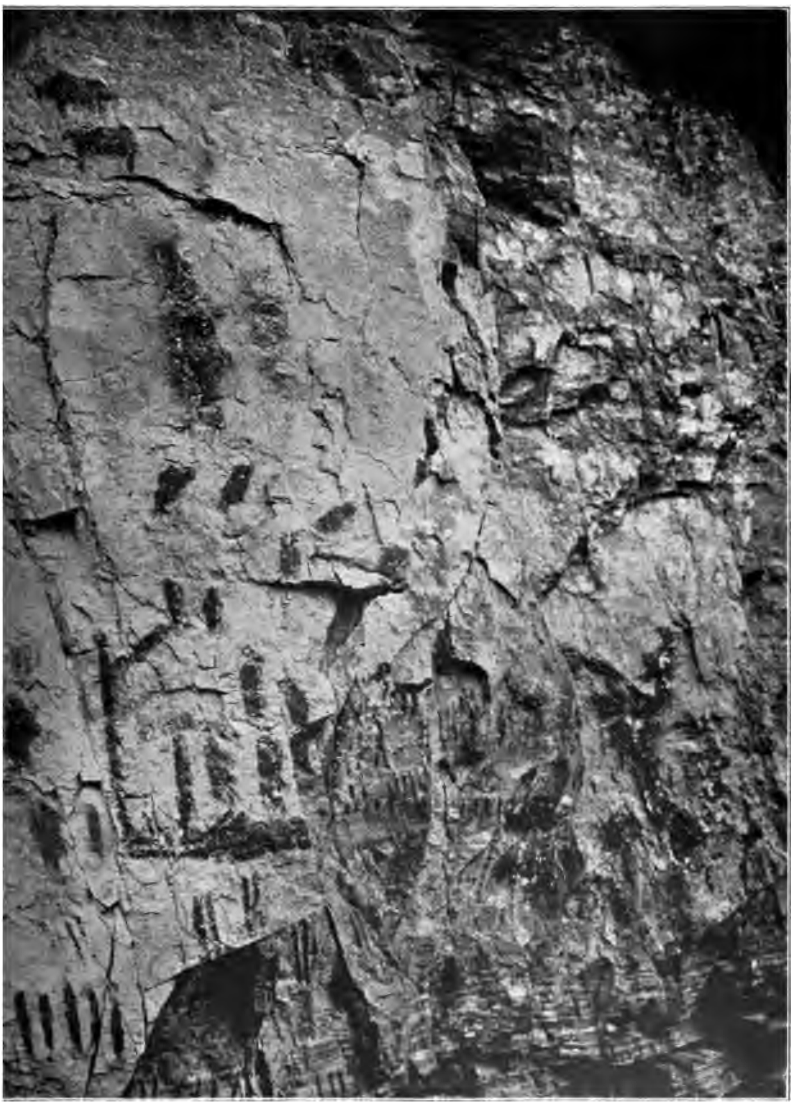


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PLATE II

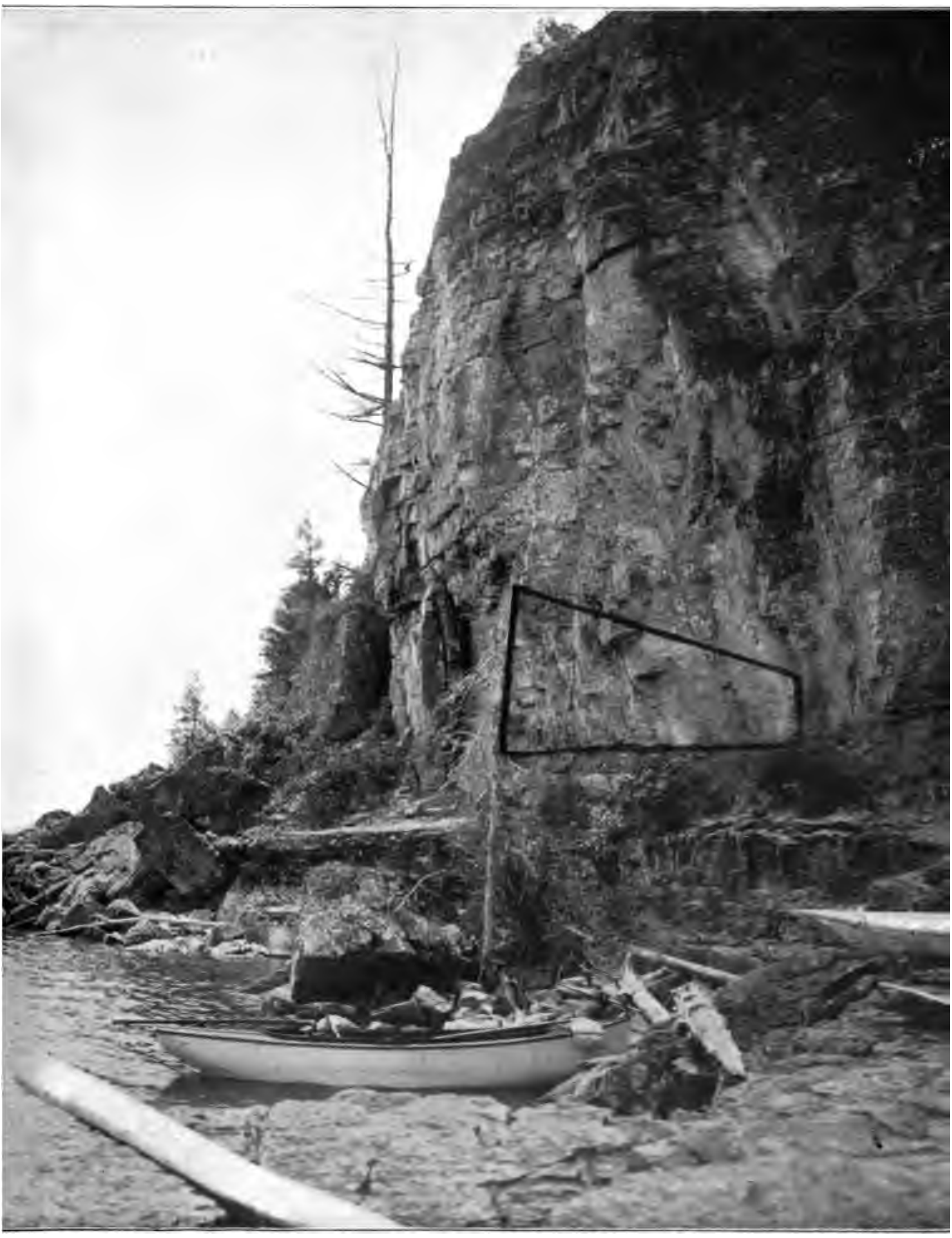

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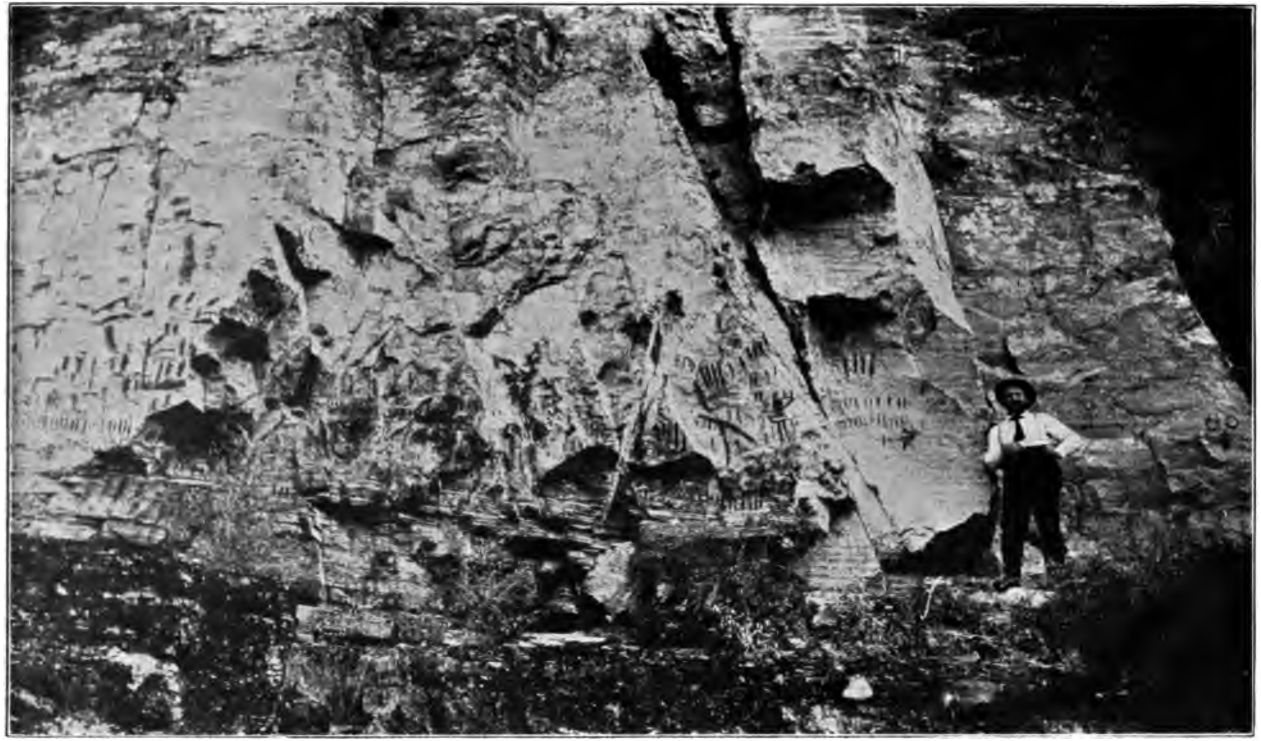
PLATE IV



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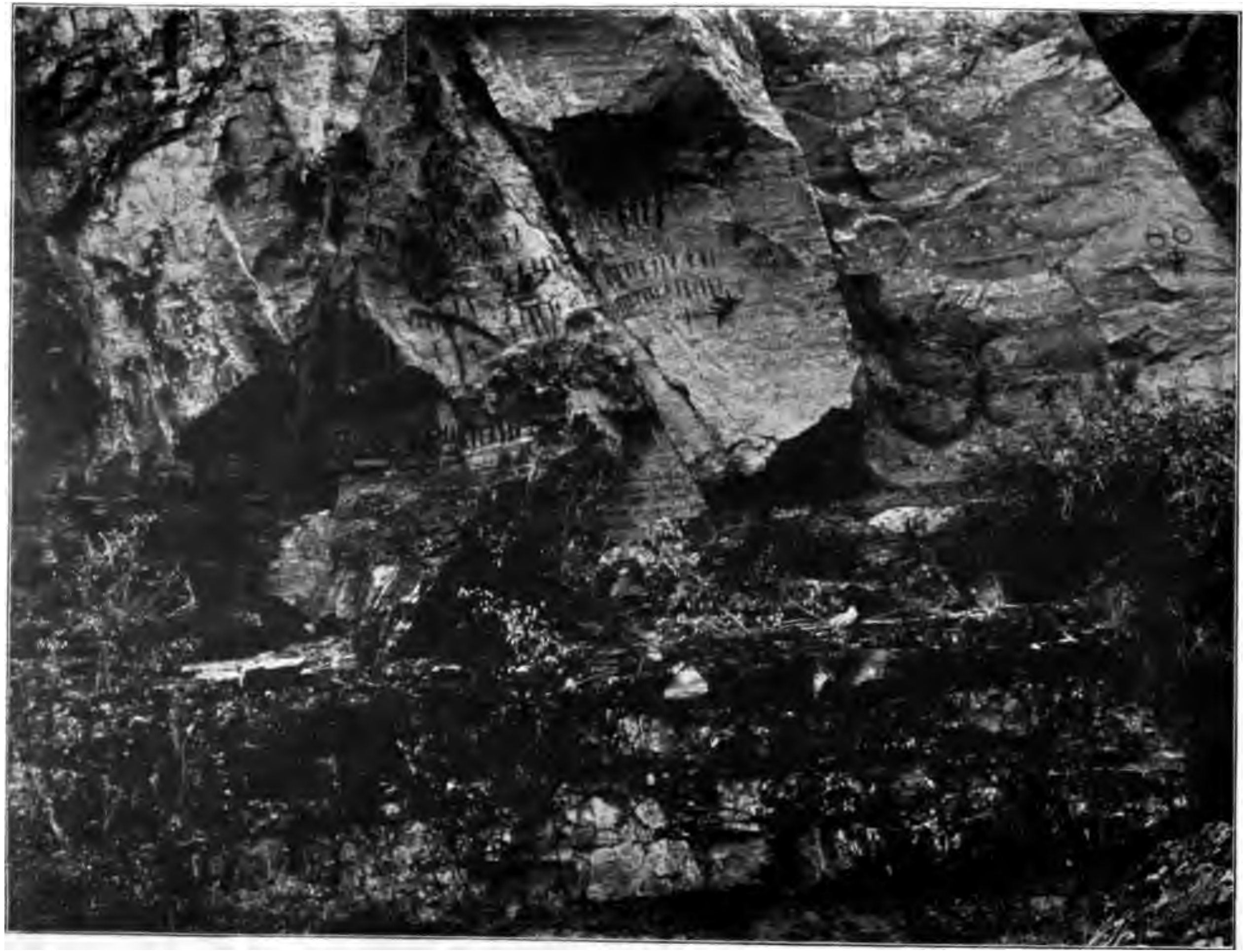

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BULLETIN, UNIVERSITY OF MONTANA
BIOLOGICAL SERIES No. 15

Number 61

MONTANA BOTANY NOTES

CONTAINING

Description of New Species, List of Plants Not Heretofore Recorded
From the State, and Notes on Disputed Species,
With Five Plates

BY

MARCUS E. JONES, A. M.

Prepared From Material Collected at the
University of Montana Biological Station

UNIVERSITY OF MONTANA
Missoula, Montana, U. S. A.
March, 1910

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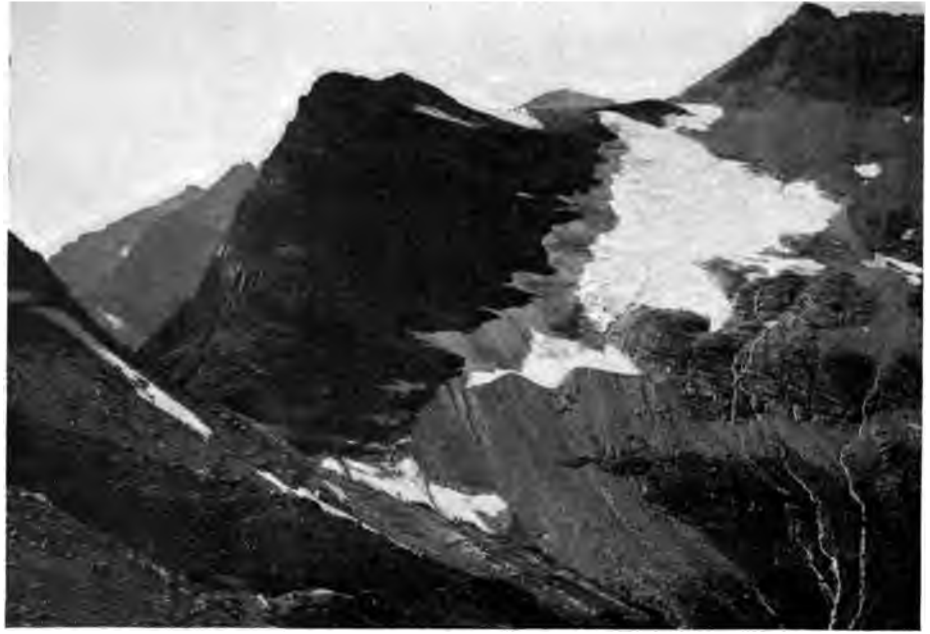

PLATE I.

Cliffs, glacier and waterfalls, looking west at Gunsight Pass, on the Hudson Bay side, continental divide, showing characteristic country in which collections of alpine plants were made.

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PREFACE

The object of this paper is simply to publish at this time the main results of the work done by Marcus E. Jones in connection with the Biological Station at Bigfork, so far as important notes, changes of names due to exhaustive field work and new species are concerned. The ecological work and detailed statement of species and localities, zonal distribution, etc., are reserved for a subsequent paper. In addition such additions to the Flathead drainage flora as have been made by Prof. Elrod, Miss Norton and others are here given for the first time, and credited to them. The total flora passed in review covers some 1700 species. The flora of the Flathead Lake region has now been thoroughly worked up except the early spring flora which is meager. It has been the Mecca of botanists for over a decade, but the only publications on its flora have been a paper on the trees, and one on the lichens and mosses and fungi, all of them very incomplete, and sporadic articles on the ferns and horsetails. The collections of Williams, Mrs. Kennedy, MacDougal, Canby, and others from this region have been reported in Rydberg's list of the flora of Montana. This present list does not include any commentary on the identifications of Rydberg except on a few important species of rare occurrence.

Detailed studies of the trees were made and the results are given in this paper.

The fungi on living leaves were carefully studied and collected.

A careful collection of the mosses was also made and nearly a hundred and thirty-five species were added to the known flora.

In 1908 the main work was around Flathead Lake and the adjacent mountains. In 1909 the main work was in the Bitter Root, on McDonald Peak, at Ravalli, the Flathead Plains, Swan River, and the magnificent Sperry Glacier region where the alpine flora reaches its greatest development. Work was also done at Monida and Lima in both years and along the Oregon Short Line, Northern Pacific and Great Northern railways at way stations.

NEW SPECIES DESCRIBED

Glyceria flavescens.

Carex Stantonensis, Stanton Lake Carex.

Sedum Elrodi, Elrod's Stonecrop.

Hypericum Nortonae, Miss Norton's St. John's Wort.

Cogswellia Altensis, Alta Cogswellia.

Cymopterus Elrodi, Elrod's Cymopterus.

Sambucus decipiens, The deceptive Elderberry.

Cylindrosporium simile Peck, Fungus on Ceanothus sanguinea.

Cylindrosporium simile var. pruinum Peck, n. var. Fungus on foliage of Prunus emarginata.

Roestelia tubulata Kern, n. sp. Fungus on Crataegus Douglasii.

Septoria streptopidis Peck. On living leaves of Streptopus roseus, Prosartes trachycarpa.

MONTANA BOTANY NOTES

MARCUS E. JONES

After some four or five seasons spent in various parts of Montana, the last two being in the vicinity of Flathead Lake and the Sperry Glacier region, in connection with the Biological Station work of the State, University, it seems advisable to publish at this time the new species and varieties discovered, and such changes of names as the critical field work has proved are needed. To this list is added such plants as are found for the first time within the Flathead drainage.

Polypodium vulgare L. P. hesperium Maxon. This is found sparingly from McDonald lake in the Mission mountains, to MacDougal peak, both in the alpine and Middle Temperate life-zones, and also in the Sperry glacier region. The high altitude forms are diminutive, but the plants growing around Bigfork are the normal ones and show all sorts of intergrades.

Phegopteris alpestris (Hoppe) Mett. This abounds in the alpine basins of the Bitter Root mountains at Como peak and in the Sperry Glacier region. It has doubtless been overlooked from its resemblance to Asplenium Filix foemina, and from its similar habit.

Phegopteris polypodioides Fee. This grows at Gunsight pass in the alpine basin of the lake, just south of Sperry Glacier.

Cheilanthes Feei, Moore. A form of this, with slightly larger final divisions grows sparingly at Mission Creek, and the Sperry Glacier; also found on Silloway peak by MacDougal, and at Sperry Glacier by Williams. This is wrongly referred by Rydberg to C. gracillima.

Cryptogramme Stelleri (Gmel.) Prantl. This has been found at Camass Lake by Williams, at Lake McDonald by Umbach, and by myself at Mission Creek. It grows in crevices of wet rocks, subalpine.

Pellaea densa Brack is locally abundant at McDonald lake and on Mission Creek in the Mission mountains, Middle Temperate life zone.

Asplenium viride Hudson. This is frequent on Mission Creek and at Gunsight Pass, growing in crevices of rocks, subalpine. This is what Rydberg wrongly refers to as A. Trichomanes. There are occasional stipes that are nearly black.

Polystichum Lonchitis var. scopulinum (Eaton Ferns. N. A. 2. 125 as aculeatum var.). The most marked forms of this seem surely to belong to P. aculeatum, but so far as I can find it is never found with that species, but always either with P. Lonchitis or where that naturally grows, it passes directly into that species both in Utah and Lambert Valley in the Mission mountains, where it is alpine.

Cystopteris. Underwood in the sixth edition of his fern book takes up Filix to supersede Cystopteris because Adanson in 1763 published Filix, but the genus was improperly published, as no species were named. In addition Ludwig published a genus called Filix in 1757, but also did it improperly, as there were no species named. The name Filix was taken up by Gilib in 1792 and F. bipinnata was published which is Athyrium or Asplenium Filix-foemina. Therefore the genus Filix has no standing and cannot supersede Cystopteris.

Polystichum munitum (Kaulf.) Presl. MacDougal seems to have gotten this at the foot of MacDougal peak, though it is far out of range.

Botrychium ternatun var. **Coulteri** (Underwood Torr. Bull. 25 537 (1898) as species). Darby and Swan Lake. Tweedy was right in placing this as a variety of B. ternatum, as it intergrades freely.

Botrychium ternatum var. silaefolium (Presl. Rel. Haenke 1 76 (1830) as species). Bigfork and Swan Lake. This also grades directly into the type.

Equisetum palustre L. Common at Bigfork, the Mission and Hot Springs; also on MacDougal peak.

Equisetum Telmateia Ehrh. This grows in very wet meadows Swan Lake, marsh east of Polson, Dayton.

Isoetes Howellii Eng. Abundant at Bigfork in overflowed flats. First collected by Prof. Cowles's party and referred to I. Bolanderi. Also by Fitzpatrick at Swan Lake.

Lycopodium Selago L. Lake McDonald, Umbach, Sperry Glacier and Blackfoot Glacier, alpine.

Lycopodium obscurum L. Belton.

Lycopodium complanatum L. Frequent in dark woods, Bigfork, Swan Lake, Belton, Gunsight Lake.

Selaginella rupestris var. densa (Rydberg Fl. Mont. 17 (1900) as species). This is common and varies directly into the type.

Selaginella rupestris var. Columbiana. Leaves and bracts rather abruptly contracted into a short awn. Stems diffuse and slender, much as in S. rupincola. Spikes sharply angled. Macrospores favose. Flathead Lake at Bigfork and Snake River, Idaho, near Weiser.

Taxus brevifolia Nutt. Sylva 3 86 t. 108 (1849). Yew. Ground Hemlock. This cannot be separated from the eastern T. Canadensis except by the very slightly looser sterile catkins. The habit is the same. It is separated from the T. baccata of Europe by the broader and blunter leaves. Our plant is a straggling or prostrate shrub 1-20 feet high, with trunk mostly less than an inch thick. Leaves dark green above and shining, lighter but not white below, narrowed at base, 13-25.5 mm. long, about 2 mm. wide, persistent, sharply acute at both ends, appearing flat, but convex above and concave below, with twisted petiole, the arrangement and color of upper side resembles that of Abies grandis, and the lower prostrate branches of which it is easily mistaken by the novice, especially since it often grows with the fir. The petiole is about 2 mm. long, the upper half being round except at tip, then it widens to an oblong and flat and adnate area which joins the leaf ridge of the twig as a prolongation of it. At maturity the narrow free part of the petiole breaks off irregularly, leaving a seeming and oblique knot simulating the cushion of the spruce, but has no scar at the tip as that does, because the leaf is not jointed to it there. The season's twigs are apple green, smooth, last season's twigs are reddish brown, the older ones browner, and at last flaking up in papery layers. The old bark of the main trunk is rather purplish beneath and flaky, like Thuya, but in few and short layers. It is a slow grower, with small rings; wood white with dark red center and inclined to be translucent, hard. The leaves are a kind of yellowish green color. The flowers for the next season form the fall before. This grows at Huckleberry Spring and along the Swan Lake road for half a mile or so; also at the Hemlocks, preferring damp and dark woods. Collected also by Elrod at the Hemlocks. The berries are red, juicy and sweet, with a resinous flavor, about 6.5 mm. long, soft and open at the tip, single in the axils. The branches with the leaves have the same flat, wand-like appearance of the fir and divide in much the same way, though they are more open and slender. It ranges northward and westward and in the Puget Sound region attains the dimensions of a tree. With us it is a low and straggling shrub forming dense thickets when several plants grow together, the branches matting down loosely with the snow. It is common in the mountains from Mission Creek to the British line and is a very bad shrub for mountain climbers because of its being so smooth and decumbent. McDonald Lake, Umbach.

ABIES, FIR.

Our two firs have the bracts concealed, being shorter than the scales. The trees are spire-like, with short branches either horizontal or drooping. Twigs stout. Wood soft and rather brittle, while light in weight. Good for finishing lumber, but not good for general purposes, soon rotting; not as resinous as most wood in this family. The young bark is not roughened, white or light and full of mostly large transverse blisters containing liquid resin. The older bark is very thick and corky and not flaking up, but growing in thick ridges.

Abies amabilis (Loud.) Forbes. Blankenship is right in saying that this species does not grow in Montana, but it does not appear that Rydberg intended to say (Fl. Mont. p. 12) that it grows in the state. He seems to have inserted it and described it so that it might be looked for. Surfaces of leaves not differing greatly in color, rather light.

Surfaces of leaves not differing greatly in color, rather light. Tips of trees lang and needle-like. Cones nearly black. Mostly alpine on slopes. **A. lasiocarpa.**

Surfaces of leaves conspicuously different in color, the upper dark-green and glossy, the lower silvery. Cones greenish-brown. Trees of the low lands along streams. **A. grandis.**

Abies lasiocarpa (Hook) Nutt. Sylva 3 138 (1849), pinus lasiocarpa Hooker Fl. Bor. Am. 2 163 (1842), Abies subalpina Eng. and var. fallax Eng. Everywhere next to timber line on the mountains (though not seen on McDonald peak) where it grows not only along streams, but on slopes and mesas. There it forms the chief forest tree, from 50 to 100 feet high, though it is intermixed with the spruce and pine. The branches are short, stiff and ragged, mostly horizontal. It also occurs sparingly at Swan Lake and along the Swan Lake road with A. grandis. It is usually a tree about 2 feet in diameter, and the leaves, especially the upper ones are short, rarely over an inch long and often little flattened and angled. MacDougal peak, Umbach.

Abies grandis Lindley Penn. Cycl. 1 30 (1833). Great Silver Fir. This is frequent along streams and rivers and at springs and swamps in the low lands and upward as far as subalpine, where it is replaced by A. lasiocarpa. It never forms a conspicuous part of the forest though it is a picturesque tree. All the branches are much drooping. Bark without roughness, except the blisters, which are 13-19 mm. long. On trees over 6 inches thick the lower bark begins to get corky and split. All but the season's twigs reddish brown, these apple green and minutely pubescent. Scar circular and slightly raised. Bark of old trees near the base (which are 2-3 feet in diameter) is 2-3 inches thick and corky, but gray, and the lines of fissuring are not so wavy as in the red fir, the areas smaller. It occurs all around the lake and in all the canons; also at Hot Springs. Tree often 150 feet high. Not common in the Sperry Glacier region.

Pseudotsuga mucronata (Raf.) Sudworth Cont. Nat. Herb. 3 266 (1895). Abies mucronata Raf. Atl. Jour. 120 (1832), P. taxifolia Britton, P. Douglasii Carriere. This is very common in moist woods everywhere and on moist slopes almost to timber line, thus forming a large and valuable timber tree. It forms about half of the forests in this region, preferring the uplands and well drained slopes. The wood is reddish, compact and tough, and heavy, not easily rotting. Trees often 4 feet in diameter. The outline is oblong to oblanceloate, with a short triangular tip. Twigs inclined to be reddish. Leaves rather thin, petioled, flat, appearing rather 2-ranked by the bending of the petiole, rather dark green, leaving oval scars. The bark is very thick and deeply cracked much higher up the trunk than in the firs. The branches are slender and inclined to droop. Tree cone-bearing all over and not at the tip exclusively as in the firs. Easily distinguished from the firs by the pendulous cones and reddish twigs, and from the spruces by the absence of tooth-like cushions on the twigs, and by the presence of an exserted, 3-toothed tongue under each scale, and by the very thick and corky bark, which is thin and scaly in the spruces. This tree is beginning to be killed out at Bigfoot by a borer. Polson, Umbach. Not seen in the Sperry Glacier region.

PICEA, SPRUCE.

Twigs smooth. **P. Columbiana.**
Twigs pubescent. **P. Engelmanni.**

Blankenship reports Picea alba Link from Belton and other localities, but all the plants so referred are P. Columbiana Lemmon, which replaces P. Parryana in our region.

Picea Columbiana Lemmon Gard. and Forest 10 183 (1897). White Spruce. Columbian Spruce. Whether this spruce can be separated from the P. alba of the east is still in doubt. The distinctions relied on by Rydberg do not hold, but the smooth twigs clearly separate it from P. Engelmanni, as well as its more narrow and spire-like outline of P. Parryi and habitat, which is that of the white spruce, namely along streams and in wet places, instead of slopes and mountain sides as in P. Engelmanni. The cones generally have entire and thick margined very broadly obovate scales and are narrowly elliptical before maturity. After opening they are elliptical and 1-1.5 inches long. The outline of the tree is lanceolate. Lower branches drooping and short. Twigs innumerable, white, shiny and smooth. Last year's ones tan colored and smooth, short and rigid, with the cushions not over 2-5 mm. high. All leaves very shortly apiculate, oblique at base and truncate. Bark of tree dark gray and rough to the twigs, lower bark scaly and thin, but the whole tree is without scaly bark up to 6 inches in diameter and is finely roughened all over. The tree is never blue like P. Parryi. It is seldom over 2 feet in diameter and often 100 feet high. The largest tree seen was 12 feet 9 inches around. It is not common, though it is found in all localities up to the subalpine. Kalispell, Williams, also Belton. Alta, Lake McDonald. Not on the Atlantic slope. Deer Lodge Valley.

Picea Engelmanni (Parry) Eng. Trans. St. Louis Acad. 2 212 (1863). Abies Engelmanni Parry same citation. Engelmann's Spruce. This is a tree with oblong outline and rather rounded top, mostly 50 to 75 feet high and 1-2 feet in diameter, much wider and shorter than P. Columbiana. The twigs are pendent, about a foot long. Leaves less rigid, spreading in all directions, acute, slender, mostly nearly straight, about 1 inch long. The cones are elliptical before opening, about 2 inches long and 1 inch wide, about a half longer than P. Columbiana, shortly rounded at both ends. Scales rather dark, straight, nearly entire in the type to somewhat lacerate, thin and with narrowed tips in ours, not evidently obovate. Twigs reddish and minutely pubescent. This is very abundant near timber line on all the peaks and on subalpine slopes is frequent. Elrod peak, Elrod. It is the only spruce on the Atlantic slope. The wood of both species is compact and hard and tough and nearly white and makes fine lumber. It is shipped as Oregon Fir all over the west. The bark is characteristic, being thin and very flaky and reddish, not forming thick ridges as in the firs, it exudes much resin, but there are few or no blisters as in the firs and is not smooth as in the firs. It is at once separable from Parry's spruce by the pubescent twigs and dark and short cones, while the twigs of the other are smooth, and the cones apple green and often 4 inches long, and the scales are thin and very lacerate, with narrow tips.

TSUGA, HEMLOCK.

The hemlocks are the most graceful and beautiful of the evergreens. Their tall and spire-like outline, with needle-like tip, and their long and drooping slender branches with quill-like twigs, 2-4 feet long pendent and dangling their clusters of cones in flat wands could be mistaken for the spruces by the casual observer. The trees are mostly 100 to 200 feet high and grow in dark and damp woods along rivulets at the bases of the mountains or alpine and are rare.

Plants of the Middle Temperate zone, cones .5-1 inch long. **T. Mertensiana.**
Alpine, cones 1.5-2 inches long. **T. heterophylla.**

Tsuga heterophylla (Raf.) Sargent Sylva 12 73 (1898), Abies heterophylla Raf. Atl. Jour. 119 (1832). Western Hemlock. This is a tree with the habit and appearance of the pyramidal forms of Juniperus scopulorum, and also

Picea Columbiana, but the tip more needle-like, habit about that of Cupressus Arizonicus. The branches droop and the fruiting twigs are pendulous in clusters. It grows along with the firs, some trees being 50 to 60 feet high with us. The branches are very many, rather dense and with many twigs. Season's twigs barely 2 mm. wide, drooping as are also all the younger twigs of 2-3 years' age, very pubescent with spreading hairs, 2-6 inches long, round. reddish yellow, the convex leaf ridges 4.5 mm. long and ending in a dark red appressed and truncate cushion about as broad as long, to which the twisted and flattened leaf petiole, about 2 mm. long is jointed. Leaf blade 13 mm. long, 1 mm. wide, entire, flat, with one dorsal groove and low convex back, and concave lower side, very dark green above and glaucous below, apex obtuse and rounded, base triangular-acute and set at an angle to the petiole, smooth. Last season's twigs light-reddish brown, 3-year-old twigs reddish brown, with papery bark splitting between the leaf ridges and flaking up like birch bark, the leaf cushions falling off with them. Twigs that are 13 mm. thick also have reddish brown papery bark scaling up somewhat. The older bark scales up like the spruce, but is more shreddy, like the Arbor Vitae. Cones apple green, pendulous on twigs 1-2 inches long, about 1 inch long, 11 mm. thick, elliptical-lanceolate, acute, smooth and waxy, but apparently puberulent when young. Scales 13 mm. long, elliptical-oval, with very narrow and reddish and entire margins. Seeds very small, 2 mm. long. Wings 4 to 6 times as long and very thin and rounded. Bracts not visible in the green cones. Wood white and soft and very flexible, with red center. This is very rare in our region so far as known, A few individuals grow at the Hemlocks at the foot of MacDougal peak near Echo Lake and at Swan Lake. It also abounds in the Sperry Glacier region. It does not grow on the Atlantic slope.

Tsuga Mertensiana (Bong.) Carriere Trait. Conif. Nouv. Ed. 250 (1867). Pinus Mertensiana Bong. Mem. Ac. St. Pet. 6 2 45 (1832). Tsuga Pattoniana Eng. Black Hemlock. Leaves 13-25.5 mm. long, angular, acutish, narrowed below, often arched, keeled on both sides, unequal and appearing as if in clusters. Cones 1.5-2 inches long, cylindrical, 13-17.5 mm. thick. Seeds 5 mm long, with an obliquely abovate wing. This has been reported from the Sperry Glacier region, McDonald peak and Bitter Root mountains, but it is doubtful if it grows east of the Cascades. It has probably been confounded with the longer coned forms of the above. The Sperry Glacier species is not Mertensiana.

Blankenship in his additions to the Montana flora quotes Tsuga Mertensiana records from various Government reports as occurring on the high mountains. All these records are errors, for Picea Columbiana, whose cones resemble the Tsuga. No Tsuga grows at high elevations in Montana. They all belong to the Middle Temperate life-zone.

JUNIPERUS, JUNIPER, CEDAR.

Alpine shrubs mostly, tufted from the root and prostrate or widely spreading with sharp and prickly leaves about 12 mm. long. Berries in the axils. **J. communis.**

Not alpine. Leaves scale-like (sometimes needle-like in Virgiana).

  Prostrate or decumbent at base, shrubs, **J. Sabina.**

  Trees or shrubs, with distinct and erect trunks. Berries terminal.

    Leaves with entire margins, in pairs. **J. Virginiana.**

    Leaves with plainly denticulate margins, mostly in threes. **J. occidentalis.**

Juniperus communis L. 1040. The type is a small tree with a trunk, and does not occur with us.

Juniperus communis var. **depressa** Pursh Fl. 2 646 (1814). Depressed variety. This is the common form at low elevations growing in the open woods on flats where the stems are many from the root and decumbent at base and then ascending 3 to 4 feet high, forming a kind of bowl shaped mass 6 to 10 feet in diameter. Common all along the eastern side of the Lake in the Middle Temperate life-zone. Occasional in the Sperry Glacier region, especially on the Atlantic slope.

Juniperus communis var. **montana** Ait. Hort. Kew 3 414 (1788). **J. Sibirica** Burgsti., **J. communis** var. alpina Wall. Alpine variety. This forms dense mats at and near timber line and is mostly prostrate throughout and usually has shorter and blunter leaves. The berries of both the varieties are blue with a white bloom and are barely edible. The species has little use in Montana, though the branches make good floors for beds. The plants have a strong odor when bruised and produce juniper oil in abundance when distilled. The berries form a portion of the food of grouse at high elevations and the mats form the best of shelter from enemies and the weather. It grows best on steep ridges and exposed slopes and cliffs. MacDougal peak, MacDougal; also Umbach. It is common.

Juniperus Virginiana L. 1039. Red Cedar. Red Juniper. This is the characteristic tree of the Lake shores, being found everywhere just at the storm line. It also grows on subalpine cliffs straggling over the rocks. Along the shores it occurs in two forms, the more common one being a bushy and rounded clump with one or more trunks 10 to 20 feet high growing on rocks or shallow soil. Where the soil is deep it assumes the proportions of a tree even 75 feet high and often pyramidal in outline. It varies in thickness from a few inches to almost 2 feet. The bark is rather thin and dark. The branches are smooth and olive colored and do not flake up at all for several feet in length, then they flake slowly, but not at all as in the variety which grows in more arid conditions and therefore flakes up more quickly. The inner bark is dull and the wood of the twigs white to the core. The spray is fine and open. Berries about 2 mm. wide and blue when ripe. The wood of the old trees has a narrow white band near the bark, the rest is dull red and not purplish as in the variety. The odor is strong and aromatic. The texture of the wood is compact, very fibrous and splitting into very slender splinters, very flexible, heavy. It makes the best of fire wood, good posts, is rarely large enough for lumber and is much used as an insect exterminator because of the strong odor. The bark of the main trunk is not evidently shreddy, but is deeply cracked in narrow ridges, and it never hangs in long shreds floating in the wind as on the white juniper. Where the bark cracks up on the twigs it does so in rectangular pieces, not in papery shreds. The distinction of rounded top separating this from the variety amounts to nothing. The ripening of the berries is indifferently annual or biennial, though in the typical species it is more nearly annual. The only distinction that amounts to anything between this and the variety is the finer spray, smaller berries and dull purple wood. Also at McDonald peak at 5,500 alt.; Wild Horse Island, Elrod; Bigfork, Umbach. Not seen in Sperry Glacier region.

Juniperus Sabina L. 1039. Creeping Juniper. This belongs to the Virginiana section and is creeping, flat on the ground for the most part. It grows on dry slopes, but does not seem to be nearer our region than the Atlantic slope, except at Garrison and Upper Marias Pass and Deer Lodge Valley.

Juniperus Virginiana var. **scopulorum** (Sargent Gard. and Forest 10 420 (1897) as species). This variety does not grow in the Flathead region unless it occurs on the west side on rolling hills. The wood is bright purple, the berries about 4.5 mm. wide, the spray much shorter and a little thicker, and the bark of the twigs flaking up except for a short distance near the ends into small blocks and leaving the purplish under bark exposed. It abounds on dry hills and cliffs where the rainfall is less than 20 inches per annum throughout eastern Montana and southward through Idaho. In Utah it is found only in the mountains on cliffs and slopes. It is mostly with rounded top, but is occasionally pyramidal, but rarely reaches 50 feet high then. The differences between the type and variety are only such as would occur in a moister climate. There is a Coast form of this plant along the Sound whose relationship is not yet fully established, but it is probably only the most developed form, due to better soil and still more humid climate.

Juniperus occidentalis Hooker Fl. Bor. Am. 2 166 (1840). Western White Juniper. This has not yet been reported from our region, but is likely to grow west of the Lake on the dry hills. It is characterized by the thick twigs, large berries, compact spray, rounded apple tree-like top and very stout and erect trunk 1 to 2 feet thick, as well as by the leaves being in threes.

THUYA, ARBOR VITAE.

Thuya plicata Donn Hort. Cantab. Ed. 6 249 (1811). T. gigantea Nutt. Giant Cedar. Arbor Vitae. Cedar. This is a very tall and graceful tree, outline conical, or linear-subulate in cross section, with spreading and much drooping branches. The scale-like leaves green and shining, acuminate, rather pubescent. Cones clustered toward the ends of the twigs, 13 mm. long, the scales with a thin and acute mucro. Wood is fine grained, very flexible and soft, light colored, reddish at center, durable, splitting readily into fine flakes and much used for shingles. With us it is a slender tree rarely a foot thick and 100 feet high, growing on wet north slopes along with the larch and fir in the shade. The bark shreds up into long and thin flakes 1 to 2 feet long, which are reddish. The upper stems smooth and light brown. Branches many and slender. It is at once recognized by the scale-like leaves arranged on branches, forming great flattened wands, and by the cones. Huckleberry Spring, on the Swan River road. This is sold as white cedar by the lumbermen throughout Montana. Common at McDonald Lake in the Mission Mountains. Not seen on the Atlantic slope.

At both lakes there are magnificent forests with some trees 4 feet in diameter.

CHAMAECYPARIS, YELLOW CEDAR.

Chamaecyparis Nootkatensis (Lamb). Spach. Hist. Veg. 11 333 (1842). Cupressus Nootkatensis Lambert Gen. Pin. 2 18 (1824). This has been reported from near our region, but is probably an error for the Thuya.

PINUS, PINE.

- Leaves less than 5 in each cluster. Bark rough.
  - Leaves in twos, 2-3 inches long. Cones persistent for years, small, about 1.5-2 inches long, obliquely-triangular-ovate when closed. Slender trees with many and mostly whorled branches. **P. contorta.**
  - Leaves in threes, rarely in twos, about 6 inches long. Cones oval 3-4 inches long, dark-purple. Branches seldom opposite, few, large. Very large trees **P. ponderosa.**
- Leaves in fives. Bark smooth on all the upper part of trees, very resinous. Wood soft and white, rather brittle.
  - Cones ovate to almost round, very dark, rarely 3 inches long. Low and scraggly trees growing in rocky places in subalpine situations. **P. albicoulis.**
  - Cones nearly apple-green, cylindrical, 4-8 inches long.
    - Low and scraggly trees, widely branched. Leaves rigid, dark-green. Branches few and large. **P. flexilis.**
    - Tall and stately trees with slender, weak and light-green leaves. Bark oak-like. Branches whorled and many. **P. monticola.**

Pinus contorta Douglas in London Arb. Frut. 4 2292 f. 2210, 2211 (1838). What corresponds partly with the type of this species is a small and scraggly tree growing at timber line on McDonald peak, and probably elsewhere. It has small and very oblique cones not opening for several years after maturity and slender leaves 1 to 1.5 inches long. The type is a tree of the wet coasts of the Sound in a very different life zone. Upper Marias Pass, Lake Louise.

Pinus contorta var. **Murrayana** (Murr.) Eng. Bot. Cal. 2 126 (1880), Pinus Murrayana Murr. Bot. Exp. Oregon 740 t. 3. f. 2. (1860). Lodgepole Pine. This is a strict and slender tree with tapering trunk, growing in dense thickets and singly all over the mountains to timber line in dry places, horizontal, slender, whorled branches. Cones clustered, about 2 inches long, with strong knobs and slender prickles. The bark is thin and scaly and light-brown, and rough even to the twigs, not conspicuously resinous. Leaves 2 to 3 inches long. Outline of tree is lanceolate with an acuminate tip. This is the most common evergreen in the region taking it as a whole. There are few places where it has reached the dimensions of a lumber tree because of the frequent fires, but back of Yellow Bay it forms immense thickets over square miles of land, growing so thickly that it is difficult to force one's way through it afoot. It is everywhere on the slopes of McDonald peak, is very abundant on the uplands back of Bigfork going up to the limit of the subalpine at 5500 feet. It is occasionally 150 feet high. The wood is tough, hard, compact and reddish, and when large enough makes fine lumber. It is much used for poles for fencing, for posts and the like. Everywhere to the top of the mountains in the Bitter Root valley. Occasional on both slopes in the Sperry Glacier region.

Pinus ponderosa var. **scopulorum** Eng. Bot. Cal. 2 126 (1880). Yellow Pine. This is a magnificent tree 100 to 150 feet high, with straight trunk tapering but little, the lower branches falling early and only here and there a great branch straggling off, trunk often 100 feet long without a branch and 2 to 6 feet in diameter, with brick-colored, thick, flaky bark cracking up into great flat areas 2 to 4 inches wide and a foot or more long. The very slender leaves are about 6 inches long in swabs at the ends of the twigs. The cones before opening are oval-olong, 3 to 4 inches long, but on opening are about oval-ovate, dark colored. Prickles stout and incurved. Wood rather yellowish, compact, tough, heavy. Leaves often in twos. The cones and leaves vary greatly. This is the great lumber tree of the region. It abounds on the mainland on tablelands and slopes to the subalpine at .5500 feet alt. in dry places and on all the shores and islands of the lake. It never grows in thickets, even the seedlings do not grow close together as with the lodge-pole pine. Bigfork, Umbach. Everywhere to the top of the mountains in the Bitter Root valley.

Pinus albicaulis Eng. Trans St. Louis Acad. 2 209 (1868). White-barked Pine. Bastard Alpine Pine. This grows at high elevations at and near timberline on all the mountains on the edges of rocky meadows and slopes and ridges. It is a scraggly tree, generally with the trunk dividing into two or more great limbs which are tortuous or curved and sparingly branched with short and thick twigs and smaller branches whose swollen bark is full of pitch. The leaves form narrow swabs at the ends. The nearly black cones are single to clustered near the ends, and are heavy but small. The main trunk is a foot or two thick with rather thin bark cracking into oblong areas flat on the top much like the oak. The wood is soft and white and full of resin and very brittle, of little value save for fuel. Trees rarely over 50 feet high growing along with the alpine fir and red fir. Common at timber line on both slopes in the Sperry Glacier region.

Pinus flexilis James Long's Exp. 2 35 (1823). Bastard Pine. This is not yet known nearer than Deer Lodge valley. Its cones are narrow and over twice as long as in albicaulis and the tree grows in the Middle Temperate life zone mostly but in other respects much resemble it.

Pinus monticola Douglas in Lamb. Desc. Pin. Ed 2, 3 27 t. 87 (1837). White Pine. This is the most magnificent pine of them all. It often grows to 200 feet high, with a straight symmetrical and clean trunk, with thin (except at base) and oak-like bark. It is often 6 feet in diameter but is still a slender tree. It has an airy apearance because of the rather long internodes and the almost thread-like and glaucous leaves 2 inches long.

The cones are resinous, light but ofen 8 inches long, few and almost always at or near the tip of the tree. The bark is olive-gray and smooth on all the branches and even the trunk for many feet down. Bark of the main trunk below is light-gray, cracked into small rectangular and oblong areas 1 to 2 inches long which are not flaky and never over an inch thick and flat-topped. Outline of tree is linear with an acuminate tip. It branches like the lodgepole pine but is more open and with branches longer and flexible. It grows along the Swan Lake road sparingly in moist places and in the fir forests near the Hemlocks in the most magnificent proportions. It is remarkably free from knots. The wood is white and soft. It is considered the best timber tree of all, but is not plentiful. Not found on McDonald peak nor on any of the islands. Lake McDonald, Umbach. Locally abundant in the Lake McDonald region.

LARIX, LARCH, TAMARACK.

Alpine, twigs and bud scales woolly. **L. Lyallii.**
Plants of the Middle Temperate life zone. Twigs and scales smooth. **L. occidentalis.**

Though the larch differs superficially from Picea in a marked degree in the deciduous and fascicled secondary leaves, yet it is closely related to it in all permanent characters as is shown by the development of the young plants and the character of the primary leaves. Its arrangement with the pines is a wholly artificial one for ease in classification.

Larix Lyallii Parl. Enum. Sem. Hort. Reg. Mus. Fl. 259 (1863). Alpine larch. This tree grows at and near timber line on the high peaks. It is seldom 100 feet high and branches rather low down into one to three large and candelabrum-like divisions which are mostly erect above the curved base. The trunk is large for the height and straight, seldom making more than one length of good lumber. The bark and wood are much the same as in the western larch. It grows on rocky slopes and among glacial boulders, never in wet places. In our region it has not been found on the Flathead Lake side of any of the ranges but occurs on the eastern side of the Swan range in the alpine basins but sparingly. It has been found on Elrod peak, Mt. Lo Lo, also by Jones in the main range west of Hamilton. It also occurs on Mt. Haggin back of Anaconda and probably southwestward to the Sawtooth and Seven Devils mountains, Idaho and the Blue Mountains or Wallowas of eastern Oregon. It extends northward into British America and westward. Not seen in the Sperry Glacier region.

The following field study of Larix Lyallii growing on Como peak was made this year. Subalpine. Young trees much like L. occidentalis but more widely branched. Bark rough and cracking up into irregular and thick flakes like Pinus Murrayana on the base of trees that were only 4 inches thick. Upper bark light gray and smooth, powdery or granular. Two-year-old twigs the same in color and with thin hair-like flakes or fibrous shreds. Last year's twigs chestnut-colored and woolly. Season's twigs were woolly and green and with single leaves as in the other species. Regular leaves needle like and a little tapering at base, very soft, about an inch long. Cones erect even when the twigs are pendent. Scales erose and puberulent at tip, deep purple. Branches very slender and pendent often. Outline of old trees ovate. Branches large, dichotomously several times branched. Habit more that of Pseudotsuga but more open. Branches either ascending or drooping. Trunks sometimes forked and candelabrum-like, but mostly simple.

Larix occidentalis Nutt. Sylva 3 143 t. 120 (1849). Western Larch. Tamarack. The young season's branches have raised ridges along the stem like the spruce, which end abruptly in an oblique scar to which the primary leaves are jointed, but this scar is not horizontal at the end of a short and woody and persistent pedicel as in the spruces, but the leaves of both are single in a place like the firs. The second year the twigs are roughened by these now leafless ridges though otherwise smooth and are tan-colored. After the twigs are two years old they are covered by resinous particles like warts and are dark-gray or brown. The outline of the tree is linear-lanceolate and it appears sparsely branched with relatively very short branches which are often clustered in bunches, mostly alternately, and mostly drooping. Twigs either erect or pendulous. In young trees especially the twigs are often several feet long and droop like the weeping willow forming very beautiful and symmetrical trees. The tree is much infested with mistletoe which produces great knobs from which arise innumerable branchlets. Season's twigs about 2 mm. thick, dull-red, very slender, a few inches to a foot long as a rule, slightly pubescent, arising from the wart-like knobs of the previous year, except the terminal twig which arises from the bud of the previous year, but even it has at its base the rosette of secondary leaves which is characteristic of the knobs and also has the knob there. The second year the lateral buds of the first year produce rosettes of many leaves and also thicken into warty knobs about 6.5-9 mm. long and wide which persist in the stem indefinitely and give it its very knotty appearance. The third year these knobs develop twigs from the center and a second rosette of leaves at the base or produce sterile or fertile cones with a rosette of leaves at their base, or often produce only another rosette of leaves. The twigs of the season have the basal rosette leaves about 2 inches long, 6.5 mm. wide and 3 mm. thick, they are obtusely 4-angled, needle-like, but a trifle wider above and with a very short point at the rounded tip. These leaves gradually pass into the primary leaves of the twigs which are about 1 inch long above and nearly the same width throughout and with a short and aculeate tip. These leaves are alternate, one in a place, terminating a leaf-ridge which is exactly like hemlock (that is convex on the back and chestnut-colored, ending in a truncate projection which stands out its width above the end of its attachment where it is jointed squarely to the leaf which is sessile and without a petiole, and is deciduous, this projection after a year or two being only a knob in the bark and thus differing from the spruce). Therefore the larch and hemlock are the nearest related, and both are closely related to the spruce. The cones mostly fall when ripe but sometimes persist a year, especially when they produce a rosette of leaves at the tip which occurs frequently. Rarely they produce season's twigs from the tip and the upper and sometimes the lower bracts are altered into leaves, but with the center of the cone still seed bearing. The cones are 1-2 inches long, .75-1 inch wide, rounded at both ends. The bracts are tridentate and with the central tooth variously prolonged but the body of the bract is not exserted, bract red to purple at least at base. Scales nearly oval, about 9 mm. wide, the tips recurved a trifle and a little erose, about 13 mm. long. Wings of seeds half-ovate and as long as the scales, very thin, rounded. The cones ripened on Sept 1st, this season at Bigfork but at Coeur d'Alene Lake they were not ripe two weeks later though the elevation was much less, they seem to mature at once after frost. The bark of the older twigs is smooth and drab-colored except for the darker areas representing the old leaf-ridges which gradually widen and at last break into shallow cracks exposing the reddish under bark and letting the bark flake up in one thick layer. With age the bark gets rougher and more flaky and darker till the outer flakes fall off and leave it reddish. On the main trunk the bark is scaly and thin above, but on old trees it cracks into large and flat areas 2 to 4 inches wide and 6 to 18 inches long, reddish. The old trees have conspicuously brick-colored bark in great areas like the yellow pine but brighter. The tree is often 200 feet high, straight, with trunk tapering but little, the outline is linear-lanceolate. The branches are so small that they do not leave the wood knotty. The wood is rather reddish, soft, compact, finely grained and straight and splits readily in thin flakes. This tree forms about half of the forest of the eastern side of the Lake and by far the most lumber. The trees grow close together in dense forests and are often 4 feet in diameter. They prefer moist soil on north slopes or along bottoms and extend up to about 5500 feet altitude or the limit of the Middle Temperate zone. It is less common at Dayton, Hot Springs and McDonald peak than at Bigfork. Common in the Sperry Glacier region. Not seen on the upper Bitter Root.

Potamogeton Friesii Ruprecht. Polson Swamp.

Andropogon scoparius Mx. Dayton. This is the first time it has been reported west of the Atlantic slope.

Stipa minor (Vasey) Scribner. Common on low prairies Bigfork and Wild Horse Island.

Stipa Nelsoni Scribner. Monida, Alta, Blackfoot Glacier.

Agrostis exarta Trin. Alta, Belton.

Polypogon Monspeliensis (L.) Desf. Ravalli.

Calamagrostis neglecta (Ehrh.) Gaertn. Evaro, Alta.

Calamagrostis blanda Beal. Daphnia Lake at Bigfork. Too close to C. Canadensis.

Calamagrostis rubescens Buckley. Bigfork, Swan Lake, Bull Island.

Trisetum cernuum Trin. Bigfork, Swan Lake.

Trisetum canescens Buckley. Bigfork, Alta, Evaro.

Deschampsia calycina Presl. Ronan.

Spartina gracilis Trin. Polson.

Poa purpurascens Vasey. Sperry Glacier.

Poa reflexa V. & S. Sperry Glacier.

Poa alpicola Nash. Blackfoot Glacier.

Poa leptocoma Trin. Blackfoot Glacier.

Poa pudica Rydberg. Blackfoot Glacier.

Poa interior Rydberg. Sperry Glacier. A doubtful species.

Poa crocata Rydberg. Sperry Glacier.

Poa Lettermanni Vasey. Sperry Glacier.

Poa Howellii V. & S. Daphnia Lake at Bigfork.

Poa laevigata Scribner. Deer Lodge valley, Sperry Glacier.

Poa Nevadensis Vasey. Alta.

Poa brachyglossa Piper. Monida, Alta, Evaro.

Poa confusa Rydberg. Garrison.

Poa Olyneyae Piper. McDonald Lake Mission Mts., Darby.

Poa acuminata Scribner. Lambert Valley.

Poa annua L. Ronan, Missoula, Lake McDonald.

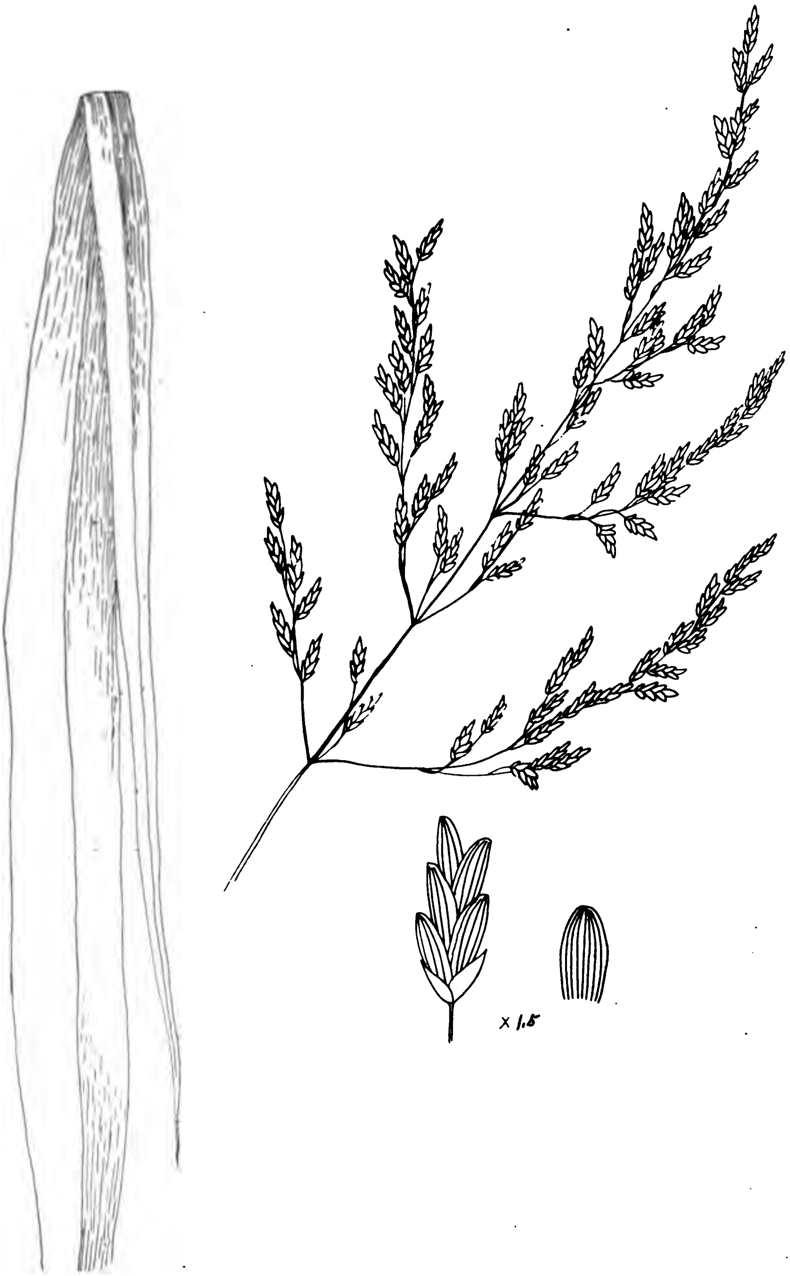
Glyceria elata (Nash Fl. Mont. 54 (1900) as Panicularia). Bigfork.

Glyceria pauciflora Presl. Ronan, McDonald Lake in the Mission Mts.

Glyceria borealis Piper. Swan Lake, Bigfork, Yellow Bay, Upper Marias Pass, Ronan.

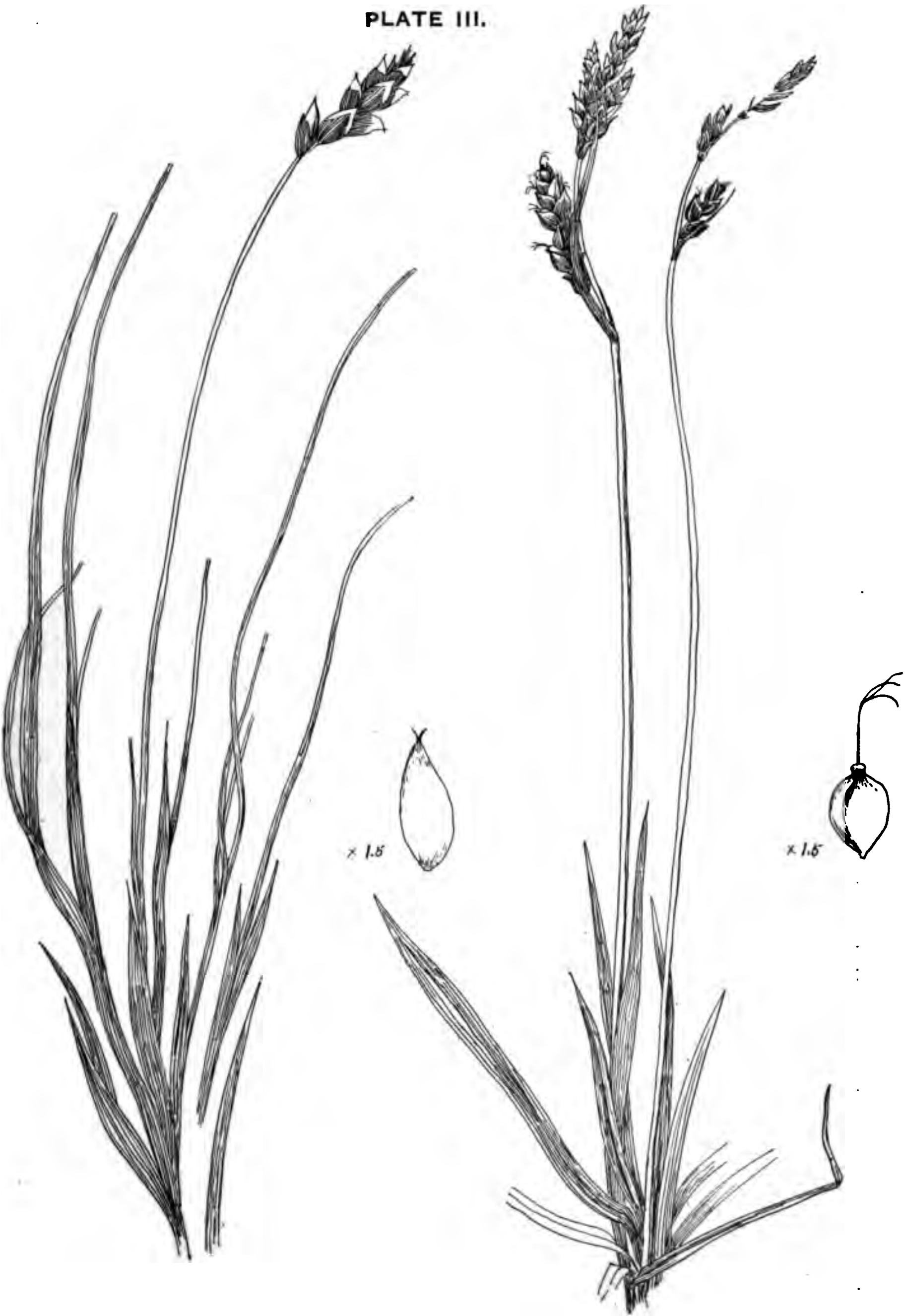
Glyceria flavescens n. sp. This is close to G. grandis, but shorter and more rigid, stems 13 mm. thick at base, erect, 2.5-3 feet high not creeping at base. Even the upper sheaths nearly as long as the internodes which are short, making the stems very leafy. Upper leaves 6 to 12 inches long and nearly 13 mm. wide, shortly acuminate, smooth except on the scabrous edges, yellowish-green, a little paler below but not glaucous. Panicle scarcely exserted, obovate-cuneate, very dense, erect, with several erect rays at each joint which branch repeatedly, only the upper branches spreading. Spikelets linear-lanceolate, acute, about 11 mm. long, about 5-flowered, grennish-yellowish. Glumes hyaline, white, turning tawny with age, the upper 3-nerved at base. Lemma narrower and a trifle longer and less scabrous than in G. grandis, not turning purple. This has the habit of Phragmites and grows in large patches in bogs. Gathered at Swan Lake Aug. 24, 1908 while G. grandis at the same place was all out of bloom and even the seed fallen two weeks earlier. It differs from G. grandis in the swab-like panicle, lutescent flowers and leaves, broader

PLATE II.



GLYCERIA FLAVESCENS JONES N. S.

PLATE III.



CAREX STANTONENSIS JONES
N. S.

CAREX PARRYANA VAR HALLII
BAILEY

and shorter leaves, short internodes and very leavy stems, and much later flowering season. Middle Temperate life zone.

Festuca Hallii (Vasey) Piper. Bigfork, MacDonald peak.

Bromus Pumpellianus Scribner. Alta. Blackfoot Glacier, Bigfork.

Bromus Richardsoni Link. Bigfork, Swan Lake, Ravalli. Also the var. pallidus (Hook.) Shear, MacDougal and McDonald peaks, Wild Horse Island, Whitefish and Bigfork.

Bromus tectorum L. Missoula, Colville.

Bromus marginatus Nees. Bigfork, St. Ignatius Mission, Ronan, Ravalli Alta, McDonald Lake in the Mission Mts.

Melica stricta Bolander. Blackfoot Glacier.

Melica bella Piper. Alta.

Agropyron occidentale Scribner. Bigfork, Ronan, McDonald Lake in the Mission Mts., Upper Marias Pass, Browning.

Agropyron lanceolatum S. & S. Wild Horse Island.

Argopyron biflorum (Brign.) R. & S. Alta.

Argopyron Scribneri Vasey. MacDougal Peak.

Elymus triticoides Buckley. Ravalli, Blackfoot Glacier, Browning, Upper Marias Pass.

Elymus glaucus Buckley. Ravalli.

Elymus Canadensis L. Bigfork, St. Ignatius Mission, Yellow Bay, Wild Horse Island, Upper Marias Pass.

Scirpus riparius (R. Br.) Spreng. Monida.

Scirpus robustus Pursh. Bigfork, Hot Springs, St. Ignatius Mission.

Scirpus microcarpus Presl. Darby.

Scirpus microcarpus var. **robrotinctus** (Fernald Rhodora 2 20 (1900) as species. This hardly deserves varietal rank, all sorts of intergrades occur constantly. Alta, Bigfork, Swan Lake, St. Ignatius Mission, Hot Springs, Polson Swamp, Bull Island, Common.

Eriophorum gracile Roth. ..Sperry Glacier.

Eleocharis rostellata Torr. Hot Springs.

Carex Deweyana var. **sparsiflora** Bailey. Yellow Bay in damp and dark woods.

Carex nardina Fries. This plant is very common on all the alpine peaks and rocky meadows of the Sperry Glacier region, and in Lambert Valley in the Mission Mts. Though it agrees with other material from the Cascades sent out by the Gray Herbarium, it does not accord with the usual character given this species. In case it should prove distinct it may bear the name **Carex Stantonensis.** Densely caespitose, with many large and brown sheaths like C. filifolia, and with thick crowns. Root leaves many, filiform, channeled, smooth, truncate, rigid, erect, .5 mm. wide, about 4 inches long and as long as the stems which are filiform. Spike single, inclined to be clavate and narrowed below, but acute at tip. The two lowest perigynia contiguous, the rest imbricated closely. Spike staminate at tip and with few stamens, 13 mm. long, 5 mm. wide. Bracts none. Scales ovate-oval, acute, fully 2 mm. long, chestnut-colored but with lighter midrib, closely investing the perygynia and fully as wide, very thin, with entire edge. Perigynia closely appressed but with tip inclined to turn out, manifestly inflated and with papery covering, about a third longer than the akene and inclined to wrinkle lengthwise as if nerved, tip a little oblique, with very short oblique beak, not cleft down the outside to speak of and nearly entire. Perigynia white except the chestnut-colored tip, about as long as the inflated scale, smooth except the scabrous edges above and near the tip on the back, apparently plano-convex, not winged, oblong-ovate. This is manifestly a close ally to C. Lyoni but differs in the much broader scale, while the perigynia are wanting in the mature state. It is also near to C. rupestris but the stigmas are two and not three and the perigynia are not smooth above as in that species. Collected by Williams on a mountain above Stanton Lake, Aug., 1894 and distributed as C. Pyrenaica.

Carex gravida Bailey. Swan Lake.

Carex conjuncta Boott. Polson Swamp, Whitefish, Sand Point, Idaho.

Carex diandra Schrank. Ours is the var. **ramosa** (Boott) Fernald. Bigfork, Swan Lake, Rost Lake, Ronan, Alta.

Carex stenophylla Wahl. Upper Marias Pass, Deer Lodge Valley.

Carex scirpoides Schkr. Bigfork, Swan Lake, MacDougal peak.

Carex scoparia Schkr. Evaro.

Carex Liddoni Boott. Garrison, Alta, Evaro.

Carex adusta Boott. Ronan.

Carex leptalea Wahl. Bigfork, Rost Lake, Swan Lake, Bull Island, Yellow Bay.

Carex scirpoidea Mx. Lambert Valley, rather common in the Sperry Glacier region.

Carex aquatilis Wahl. Polson Swamp, Monida, Whitefish, Silver Bow.

Carex rigida Good. Lima, Monida.

Carex lenticularis Mx. Bigfork, Swan Lake, Sand Point, Idaho.

Carex acutina Bailey. Blackfoot Glacier,, Alta, Swan Lake.

Carex Nebraskensis Dewey. Evaro, Ravalli, Bigfork, Yellow Bay, Hot Springs, Monida.

Carex Parryana Dewey var. **Hallii** (Olney) Rydberg. Whether this is a good species I am not able to say at present. Prof. Bailey also regarded it as a variety of C. Parryana and called it var unica. A detailed description of it is appended.

This appears to be near C. Pennsylvanica. Stems leafless except at very base, 1 foot high, smooth, obtusely-3-angled, filiform, 1 mm. thick, erect and stiff, light-green. Leaves several basal, 3 inches long, 4 mm. wide at base, linear-subulate, yellowish-green, flat, rigid. Bracts enlarged, chestnut-colored and scale-like at base, sheathing, the lowest with a setiform green bristle about 1 inch long below the lowest spike, the others much reduced but present. Terminal spike 19 mm. long by 2 mm. wide, sessile, all staminate, with oval mostly obtuse scales which have broad hyaline, and lacerated edges and chestnut-colored center, 2 mm. long. Pistillate spikes contiguous, about 3, the uppermost at base of the staminate one and very small and few-flowered, 4.5-6.5 mm. long, 2 mm. wide, sessile, the others longer, 13-19 mm. long and 6 to 15 flowered, loose and cery narrow, 2 mm. wide, the scales reaching about to the middle of those above on the lower part of the spike. Lowest spikes on filiform peduncles but erect, the peduncles not longer than the spikes except when the lowest spike is subradical, when the peduncle is 3 to 4 inches long. Scales very broadly ovate, barely acute to cuspidate, dark-chestnut-colored, with white and hyaline edges, about 2 mm. long, embracing the oval, very convex and smooth (but papillose with oblong bosses) perigynia, which are abruptly contracted at both ends to a short beak or stipe, faintly-several-nerved, tip with serrate edges, mostly green, 1.5 mm. long. Monida on dry prairies. Middle Temperate life zone. This differs from C. Parryana in the sheathing bracts and smooth appearing perigynia, etc.

Carex Pennsylvanica Lam. Alta.

Carex Pennsylvanica var. **pinicola.** Leaves 11-15.5 mm. wide. Pistillate flowers more numerous, plants more robust. Alta among pines on dry hillsides. Middle Temperate life zone.

Carex Idahoa Bailey. Monida, Butte, Ryan's Lake.

Carex polygama Schkuhr. Rost Lake, Monida, foot of MacDougal peak.

Carex atrata L. Sperry and Blackfoot Glaciers.

Carex atrata var. **ovata** (Rudge) Boott. Sperry and Blackfoot Glaciers. Ours answer well to C. chalciolepis but are not all copper colored.

Carex Mertensii Prescott. Blackfoot Glacier.

Carex alpina Swartz. Sperry Glacier, McDonald Lake in the Mission Mts., Darby.

Carex physocarpa Presl. Bigfork, Evaro, Alta, Ravalli.

Carex vesicara L. Bigfork, Polson Swamp, Alta.

Carex monile Tuck. Common at Bigfork, Polson Swamp, Monida, Hot Springs.

Carex retrorsa Schw. Bigfork, Rexford.

Carex retrorsa var. **Hartii** (Dewey) Gray. Polson Swamp and Swan Lake.

Carex lurida Wahl. Bigfork, Swan Lake.

Juncus Balticus var littoralis Eng. Wild Horse Island, Polson Swamp.

Juncus Drummonlii E. Meyer. Common in alpine meadows and on rocky ridges, MacDougal peak, McDonald peak, and on all the peaks of the Sperry Glacier region.

Juncus Drummondii var. **Parryi** (Eng. Rev. Junc. 446 (1866) as species). Como peak, McDonald Lake, Mission Mts.

Juncus triglumis L. Sperry Glacier.

Juncus Dudleyi Wiegand. This is one of the few segregates from J tenuis that seems to hold. Bigfork, St. Ignatius Mission, Sand Point, Idaho.

Juncus Greenei Oakes. Whitefish.

Juncus tenuis var. **anthelatus** Eng. Darby.

Juncus castaneus Smith. Blackfoot Glacier.

Juncus acuminatus Mx. Polson Swamp and Sand Point, Idaho.

Juncus alpinus Vill. J. truncatus Rydberg. Ours is the var. insignis. Common on the flats all around Flathead Lake and Swan Lake.

Juncus Nevadensis Wat. Alta, Hamilton, Wild Horse Island, Polson Swamp.

Juncus Columbianus Coville. Browning.

Luzula spicata (L.) Dec. Gunsight Pass and Sperry Glacier.

Luzula parviflora (Ehrh) Desv. Lambert Valley.

Luzula Piperi (Coville in Piper Fl. Wash. (1906) as Juncoides) Alpine meadows, MacDougal peak, Sperry Glacier, Alta.

Acorus Calamus L. Abundant at Polson Swamp and adjacent mainland, if introduced it must have been long ago.

Xerophyllum tenax (Pursh) Nutt. This abounds on all the mountains from Alta and the Mission mountains northward. It includes X. Douglasii Wat. There is great variability in the flowers.

Tofieldia glutinosa (Mx.) Pers., **T. intermedia Rydberg.** Sperry Glacier.

Tofieldia palustris Huds. Gunsight Pass and Lake.

Stenanthium occidentale Gray. Blackfoot Glacier and Gunsight Pass.

Zygadenus elegans var. **Coloradensis** (Rydberg Torr. Bull. 27 524 (1900) as species). Z. alpinus Blankenship. This intergrades freely with the type. Common mostly in alpine places, MacDougal peak and all through the Sperry Glacier region.

Zygadenus venenosus Wat. Frequent in all sorts of places and elevations. MacDougal and McDonald peaks, Wild Horse Island, St. Ignatius Mission, Yellow Bay, Polson, Bull Island, Bigfork, Evaro, Alta, Ronan, McDonald Lake in the Mission Mts. The segregates of Rydberg have no standing whatever.

Veratrum viride Ait. MacDougal and McDonald peaks, throughout the Sperry Glacier region, Upper Marias Pass, McDonald Lake, Mission Mts. This is the only Veratrum in the region though V. Californicum has been reported.

Allium Schoenoprasum var. **Sibiricum** (L.) Hartm. This hardly deserves varietal name as both forms grow together. Gunsight Pass and Lake, Belton, Upper Marias Pass.

Allium fibrosum Rydberg. Rydberg was right in separating this from A. reticulatum. Daphnia Lake, Lima.

Allium reticulatum Fraser. Common along the upper Missoula river.

Smilacina sessilifolia (Baker) Nutt. Bigfork, St. Ignatius Mission, Yellow Bay, MacDougal and McDonald peaks, Bull Island and Wild Horse Island, Alta, Upper Marias Pass, Sperry Glacier.

Smilacina stellata (L.) Desf. Bigfork, Alta.

Smilacina amplexicaulis Nutt., **Vagnera brachypetala** Rydberg. Common at Bigfork, Yellow Bay, Wild Horse Island, Bull Island, St. Ignatius Mission, Ravalli, Evaro, Alta, Gunsight Lake, Upper Marias Pass.

Disporum trachycarpum (Wat.) B. & H. Somers, Bigfork, Yellow Bay, throughout the Sperry Glacier region.

Disporum Oreganum (Wat.) B. & H. Somers, Bigfork, Yellow Bay, Ravalli, Evaro, McDonald Lake, Mission Mts.

Streptopus amplexifolius (L.) DC. St. Ignatius Mission, McDonald peak, Swan Lake, Missoula, Alta, Sperry Glacier, Gunsight Lake.

Habenaria leucostachys (Lindl.) Wat. Alta. Common in the Sperry Glacier region.

Habenaria obtusata (Pursh) Rich. Foot of MacDougal peak, Mrs. Clemens.

Serapias gigantea (Dougl.) A. A. Eaton, Epipactis gigantea, Dougl. Swan Lake at Bond's Cabin and Jeff's Cabin. First found by Miss Norton. The writer doubts the wisdom of referring this to the genus Serapias.

Spiranthes Romanzoffiana Cham., **Gyrostachys stricta** Rydberg. MacDougal peak, Bigfork, Yellow Bay, Wild Horse Island, Bull Island, McDonald peak, Gunsight Lake, Alta, Evaro.

Listera cordata (L.) R. Br., L. **nephrophylla Rydberg.** McDonald Lake, Mission Mts.

Listera convallarioides (Swartz) Torr. Bigfork, Swan Lake, MacDougal and McDonald peaks, Yellow Bay, from Lake McDonald to St. Mary's Lake in the Sperry Glacier region.

Salix Babylonica (L.) This grows in graveyards.

Salix cordata Muhl. Common at low elevations in all localities.

Salix Novae-Angliae And. Lima.

Salix Novae-Angliae Var. **pseudocordata And.** Alta, Lambert Valley, Blackfoot Glacier and Sperry Glacier.

Salix monticola Bebb. Evaro, Alta, Browning.

Salix Scouleriana Barratt. Common all around Flathead Lake nearly to the upper edge of the Upper Temperate life zone, Columbia Falls.

Salix glaucops var. **glabrescens And.** MacDougal peak.

Salix Tweedyi (Bebb) Jones. This is reported from Flathead Pass, (Upper Marias) by Blankenship, but diligent search there fails to reveal it though the following is common there.

Salix Barclayi And. Upper Marias Pass and Sperry to Blackfoot Glacier especially on the Atlantic slope. It is a curious fact that willows are relatively scarce on the Pacific slope but the moment we get on the other slope they form the chief mountain vegetation forming almost impenetrable thickets, even though the humidity is less than on the west.

Salix Barrattiana Hook Specimens gotten by Williams at Columbia Falls on the high peaks seem to belong here.

Salix chlorophylla And. Gunsight Lake.

Salix polaris Wahl. Sperry Glacier.

Salix reticulata L. **S. saximontana Rydberg.** This very variable willow abounds on MacDougal to McDonald peaks, also throughout the Sperry Glacier region, Monida, Lambert Valley. Ours are the var. nivalis mostly.

Salix Fernaldi Blankenship. Blankenship seems to be right in making a species of the western forms of S. vestita. It is characterized by the ovate pods being 2 to 3 mm long only, and the leaves not retuse but rounded at tip. The other characters given amount to nothing, particularly the pubescence and reticulation of the leaves. Young leaves sometimes show little reticulation but old ones are remarkable for it. This is frequent throughout the high peaks.

Salix desertorum Rich. Gunsight Pass.

Salix candida Fluegge. Rost Lake and Schultze's cabin.

Salix rostrata Rich. Common everywhere almost to the alpine.

Salix macrocarpa Nutt. Bigfork, Swan Lake, McDonald peak, Hot Springs, Monida, Lima.

Salix pellita And. MacDougal peak, Swan Lake, Blackfoot and Sperry Glaciers. Blankenship in his Supp. Fl. Mont. p. 46 says that S. bella Piper is a segregate from S. Sitchensis (namely is S. pellita), but this is an error, it is a form of S. glaucops with two stamens. Cusick has at last solved the relationship of S. pellita by finding that it always has one stamen and is therefore the inland representative of S. Sitchensis as suggested in my Willows p. 25.

Salix nigra has been reported from this region but all specimens so referred are **S. lasiandra.** The same is true of **S. amygdaloides.**

Salix lasiandra Benth. This is common around Flathead Lake, especially on the shores, also St. Ignatius Mission, Ronan, Alta, McDonald Lake in the Mission Mts. mostly the var. **lancifolia.**

Populus trichocarpa T. & G. This seems to be the only narrow-leaved cottonwood west of the Atlantic slope. All forms so far reported as **P. balsamifera** are this species. The only characters that seem to hold are the 3-valved pod and hairy surface, but even the latter apparently does not hold in all cases. The species abounds at low elevations everywhere.

Populus deltoides Marsh. Flathead Delta, Thompson's Falls, Bonner's Ferry, Idaho. Ours is the var. **occidentalis** with smaller leaves.

Betula glandulosa Mx. In the Torrey Bulletin for August, 1909, Mr. B. T. Butler, who was at Bigfork a few weeks in 1908 and a short time in 1909, creates several species from this and B. microphylla out of very small amount of material and from very little field study, amounting to descriptions drawn from single trees, none of which species are tenable. His segregates from B. glandulosa are B. glandulifera Butler, B. Elrodiana Butler, B. crenata Rydberg. To these might be added B. Hallii Howell. B. glandulosa varies in size and leaves according to exposure and moisture where it grows. It abounds at the cold lakes at low elevations and on up to the alpine meadows on all the mountains from Alta in the far south to the Sperry Glacier region.

Betula microphylla Bunge. The typical form of this grows in Deer Lodge valley. The common form is var. **occidentalis** (Hooker Fl. Am. 2 155 (1839) as species). This has again been the subject of much unnecessary dissection such as B. fontinalis Sargent, B. Sandbergii Britton, B. Utahensis Britton, B. Piperi Britton. It is characterized by the chestnut-colored bark till quite old, which does not peel up in thin flakes, the cambium layer not separating from the tree readily when cut, and by the tufted habit, growing in clumps from a single root. In Utah and the drier regions it rarely reaches 20 feet high and is very slender, but in the more moist places in Montana, especially along creeks it is often 30 or rarely 40 feet high and 6-8 inches through. I have seen a few trees a foot thick in deep woods where the bark peals up tardily and simulates forms of B. alba. It is almost never seen except along creeks and at springs. The shape of the bracts amounts to nothing. It is common in our region and east at least as far as Helena, and south to southern Utah.

Betula alba L. Mr. Butler takes up the paper birches and recognizes every name ever applied to them but one as distinct species almost, such as B. Alaskana Sargent, and B. papyrifera Mx. The paper birches are at once recognized by growing singly from the root and forming large trees, or at least are not tufted as in the other species. The cambium layer pops off as soon as cut through carrying the rest of the bark with it. It grows indifferently along creeks, lake shores and in dark woods in wet places.

The typical form has the bark flaking up in thin and papery white sheets even in young trees. It is very common throughout the region to St. Mary's Lake on the Atlantic slope east of Blackfoot Glacier.

Betula alba var. **pendula** (Roth Fl. Ger. I 405 (1788) as species). Mr. Butler again dissects this and makes new names out of forms such as B. subcordata Rydberg, B. Montanensis Butler, and curiously refers B. occidentalis Hooker to it, when the typical form of it is described as low and shrubby. (See DC. Prod. 16 2). His B. Montanensis is founded on a single old and partly dead tree. This shades by imperceptible degrees into the type. It is characterized by the bark peeling off more tardily and in rather thick and cardboard-like layers. This also is common in our region. This is called B. occidentalis by Blankenship in his Supp. Fl. Mont. 48.

Alnus incana (L.) **Willd.** This is very common from Alta to the Sperry Glacier region along creeks and lake shores at low elevations. The var. virescens Watson has been reported from Flathead Lake but diligent search fails to reveal it though it is common east and south but out of our range.

Alnus crispa (Dryand) Pursh. This is the A. viridis and A. Alnabetula of most writers. It is rather common on mountain sides in subalpine places going up to alpine meadows, from Alta to the Sperry Glacier region.

Oaks have been reported from our region but every case proves to be wrong so far.

Urtica gracilis Ait. Frequent in wet woods and along creeks under Willows from Alta to Gunsight Lake.

Urtica Breweri Wat. has been reported from our region but all specimens prove to be the above.

Arceuthobium Douglasii Eng. This grows on the red fir making the twigs spindle out and droop like the weeping willow, and in large tufts, it aborts whole limbs. The tufts are 4-6 feet wide and 2-3 feet thick. The parasite runs along under the bark and breaks out at the joints. It seems to bloom early in the spring, as next season's buds were forming in July. It is very common throughout our region but good fruit is seldom seen.

Arceuthobium Douglasii var. **Tsugensis** (Rosendahl Minn. Bot. Stud. 3 2 273 (1903) as Razoumofskya). This has not yet been found in our region but is to be expected on the hemlock.

Arceuthobium Douglasii var. **Laricis** (Piper Fl. Wash, 223 (1906) as Razoumofskya). This is also very common but is seldom seen in fruit. It acts in the same way as on the red fir as to aborting branches but the tufts are rigid and very knotty, and twigs are thickened, short and rigid and congested in small tufts 2-3 feet wide and a foot thick. The stems are thicker and longer on the parasite than in the type. McDonald Lake in the Mission Mts., Bigfork and Yellow Bay, both in flower and fruit, Aug. 12, 1908.

Arceuthobium Americanum Eng. Alta, on Pinus Murrayana.

Comandra umbellata var. **pallida** (DC.) Jones. Common on dry prairies and on dry mountain slopes from the Lower Missoula river to Browning.

Polygonum minimum Wat. McDonald peak and Mission Creek, also Sperry Glacier to Gunsight Pass and Lake, subalpine.

Polygonum Douglasii Greene. Common in dry and gravelly places from Alta north and east.

Polygonum polygaloides Meisner. Upper Marias Pass.

Polygonum bistortoides Pursh. Frequent on all the high peaks, also at Evaro and Mission Creek.

Polygonum viviparum L. Lambert Valley, Sperry Glacier to Gunsight Pass.

Polygonum Pennsylvanicum L. Bigfork, Echo Lake.

Polygonum Persicarioides HBK. Darby.

Polygonum Persicaria L. St. Ignatius Mission.

Polygonum punctatum Ell. Polson Swamp, St. Ignatius Mission.

Polygonum Hydropiper L. Polson Swamp.

Polygonum alpinum All. Como Peak.

Rumex pauciflorus Nutt. Monida, Evaro, Gunsight Pass.

Rumex occidentalis Wat. Swan Lake, Ronan, Alta, Browning.

Rumex crispus L. Common at low elevations from Alta northward.

Rumex salicifolius Weinm. Frequent along streams from Alta northward.

Rumex Persicarioides L. Frequent on the lake shores, also Hot Springs, Swan Like, St. Ignatius Mission, Whitefish, Browning.

Eriogonum multiceps Nees. Garrison and Monida.

Eriogonum ovalifolium Nutt. This is the alpine form E. nivale (Canby) Small. Common on all the high peaks.

Eriogonum ovalifolium var. **proliferum.** Wat. Alta.

Eriogonum umbellatum var. **stellatum** (Bth.) Jones. Alta.

Eriogonum umbellatum var. **subalpinum** (Greene) Jones. Alta, Gunsight Pass and Blackfoot Glacier, Summit.

Eriogonum flavum Nutt. Browning.

Eriogonum flavum var. **androsaceum** (Bth.) Jones. This should include E. Piperi Greene. Common on all the high peaks and very variable in the stipe.

Chenopodium hybridum L. Bigfork, Ravalli.

Chenopodium album L. Common from Polson to Bigfork and Browning.

Chenopodium glaucum L. Common on dry flats from the Hot Springs to Browning.

Chenopodium Botrys L. Ravalli.

Chenopodium rubrum L. Bigfork, Alta.

Atriplex truncata (Toor.) Gray. Common on the Little Bitter Root.

Atriplex Nuttallii Wat. Hot Springs and the Little Bitter Root.

Monolepis chenopodioides (Nutt.) Moq. Bigfork, St. Ignatius Mission, Dayton, Bull Island, Ronan, Alta.

Suaeda depressa (Pursh) Ledebour. Hot Springs and Polson.

Salsola Kali L. Common in waste places throughout at low elevations.

Amarantus graecizans L. Common in fields at low elevations.

Amarantus blitoides Wat. Ronan.

Amarantus retroflexus L. Common in fields at low elevations.

Oxybaphus angustifolius Sweet. Garrison.

Sagina Linnaei Presl. Lambert Valley, Sperry Glacier.

Arenaria tenella Nutt. MacDougal and McDonald Peaks, Lambert Valley, McDonald Lake Mission Mts., Sperry and Blackfoot Glaciers.

Arenaria verna var. **rubella** (Wahl.) Hook. MacDougal Peak.

Arenaria Nuttallii Pax. Lambert Valley.

Arenaria Sajanensis Willd. McDonald Peak, Elrod Peak (Elrod), Lambert Valley, Sperry and Blackfoot Glaciers.

Arenaria Fendleri Gray. Upper Marias Pass, Alta.

Arenaria aculeata Wat. Alta. This is probably only a form of A. congesta.

Arenaria congesta Nutt. Wild Horse Island, Alta.

Arenaria congesta var. **subcongesta** Wat. var. lithophila Rydberg. Alta, also reported from MacDougal Peak by Umbach.

Arenaria capillaris Poir. MacDougal Peak, Sperry to Blackfoot Glacier, also Elrod Peak (Elrod) and Swan Lake, MacDougal Peak (Miss Norton).

Arenaria capillaris var. **ursina** Rob. MacDougal and McDonald Peaks, also by Elrod.

Arenaria lateriflora L. Missoula and Swan Lake (Elrod).

Arenaria macrophylla Hook. Alta.

Stellaria calycantha Bong. McDonald Lake in the Mission Mts.

Stellaria borealis Bigelow. Alta, also var. **corallina.** Missoula (Elrod).

Stellaria umbellata Turcz. Sperry Glacier.

Stellaria longifolia Muhl. Alta. Missoula and Swan Lake (Elrod).

Stellaria longipes Goldie. Alta. Lolo (Elrod), Columbia Falls (Williams).

Stellaria longipes var. **Edwardsii** (R. Br.) Wat. Bigfork, Alta, Upper Marias Pass.

Stellaria longipes var. **laeta** (Rich.) Wat. Common in meadows at low elevations.

Stellaria nitens Nutt. Columbia Falls (Williams).

Cerastium nutans Raf. Alta.

Cerastium alpinum L. var. **Beeringhianum** Regel. Bigfork, MacDougal and McDonald Peaks; Yellow Bay, Dayton, Wild Horse and Bull Islands, Alta.

Cerastium alpinum var. **Fischerianum** T. & G. MacDougal and McDonald Peaks, Sperry to Blackfoot Glacier.

Cerastium arvense var. **Fuegianum** Hook. Sperry Glacier.

Cerastium arvense var. **oblongifolium** Hollick & Britton. Sperry Glacier, Mission Creek, Lake McDonald, Mission Mts.

Silene conubalus Wibel. Ravalli.

Silene Douglasii Hook. Common in the mountains at all elevations.

Silene Douglasii var. **viscida** Rob. MacDougal and McDonald Peaks, common.

Silene Douglasii var. **brachycalyx** Rob. Blackfoot Glacier.

Silene Scouleri Hook. Alta.

Lychnis Drummondii (Hook.) Wat. Browning.

Lychnis apetala L. Blackfoot Glacier.

Agrostemma Githago L. Bigfork.

Dianthus Armeria L. Ravalli. Perfectly established.

Portulaca oleracea L. Bigfork.

Lewisia pygmaea (Gray) Rob. Gunsight Pass, Sperry Glacier (Umbach).

Montia perfoliata (Donn) Howell. Evaro, Bigfork. The parviflora form Lambert Valley.

Montia parvifolia (Moc.) Greene. Lambert Valley, Sperry to Blackfoot Glacier.

Montia linearis (Dougl.) Greene. Alta, Ronan. Missoula (Elrod).

Claytonia megarrhiza (Gray) Parry. MacDougal Peak, Sperry Glacier.

Claytonia lanceolata Pursh. Lambert Valley, McDonald Lake in the Mission Mts., Missoula (Elrod).

Nymphaea polysepala (Eng.) Greene. Common in shallow lakes and near the shores of Flathead Lake from Alta northward.

Ranunculus multifidus Pursh var. **terrestris** Gray. Bigfork, Alta.

Ranunculus Purshii Rich. This is reported from our region but no valid specimens seen.

Ranunculus Flammula L. var. **intermedius**. Hook. Common on all the shores of Flathead Lake, also from Lake McDonald to St. Mary's Lake.

Ranunculus Pygmaeus Wahl. Sperry Glacier, Como Peak.

Ranunculus eximeus Greene. McDonald Lake Mission Mts. Not distinct from the following.

Ranunculus Eschscholtzii Schl. Lambert Valley, Como Peak, Blackfoot to Sperry Glacier, Elrod Peak (Elrod).

Ranunculus affinis R. Br. Bigfork (Miss Norton).

Ranunculus affinis var. **validus** Gray. The form of this with smooth seeds called R. alpeophilus Nelson is common on MacDougal Peak, McDonald Peak.

Ranunculus sceleratus L. R. **eremogenes** Greene. Common at low elevations, Ravalli to Upper Marias Pass.

Ranunculus Pennsylvanicus L. Polson Swamp, Bigfork, Whitefish.

Ranunculus Macounii Britton. Common on lake shores, Ravalli, Ronan, Flathead Lake, Swan Lake.

Ranunculus tenellus Nutt. Common on lake shores and in wet meadows from Alta northward.

Ranunculus tenellus var. **Lyallii** (Gray) Rob. Bigfork.

Ranunculus circinatus Sibth. Common, Flathead Lake, Ravalli, Ronan.

Ranunculus aquatilis L. Common at low elevations; the var. capillaceus at Bigfork; var. trichophyllus. Common, var. caespitosus at Bigfork; var. heterophyllus at Alta and Upper Marias Pass.

Ranunculus Cymbalaria Pursh. Darby, Browning, Upper Marias Pass, Missoula, Dayton, Hot Springs, St. Ignatius Mission.

Myosurus minimus L. Ronan.

Trautvetteria grandis Nutt. Alta.

Thalictrum sparsiflorum Turcz. Alta.

Thalictrum occidentale Gray. Common in open woods and mountain sides from Evaro northward. T. venulosum Trelease seems to be only a form of this.

Thalictrum purpurascens L. Ravalli, Ronan, Lolo. Gotten also at Plains by MacDougal.

Anemone parviflora Mx. MacDougal Peak, Lambert Valley, Blackfoot Glacier.

Anemone Drummondii Wat. Bt. Cal. 2 424 (1880). Drummond's Anemone. Elrod Peak (Elrod), and Mission Mts. (Elrod). Alpine. This little understood plant has alternately been referred to Tetonensis and allied species. A detailed description of it as it is may clear up some doubts. Flowers 35 mm. wide. Sepals fully 15 mm. long, oval, blue externally and white within, villous. Flowering peduncle 2.5-7.5 cm. long, 10 cm. long in fruit, stout, erect. Involucre with short and broad base, 7.5-15 cm. long, about like the leaves but large. Flowers single. Scape stout, almost none in flower, short in fruit. Plants caespitose from a thick root after the fashion of A. Hudsoniana. Leaves leathery, thrice ternate, with cuneate-oblanceolate lobes 9-13 mm. long and apiculate, nearly smooth. Styles filiform, 2.5 mm. long. Akenes long-woolly except in a narrow line on the back where it is short-hairy. Flowers about twice the size of A. Hudsoniana. Heads ovate 15 mm. long. Sperry Glacier, Lambert Valley, McDonald Lake, Mission Mts.

Anemone patens var. **Nuttalliana** (Spreng) Gray. Rexford, Garrison, Ravalli, Missoula (Elrod).

Anemone occidentalis Wat. Very common on MacDougal Peak and Blackfoot Glacier and Lambert Valley. Alpine.

Clematis hirsutissima Pursh C. Douglasii Hook. Evaro.

Clematis verticillaris var. **Columbiana** (Nutt.) Gray. Frequent from Alta to Blackfoot Glacier.

Coptis occidentalis (Nutt.) T. & G. Alta on rotten logs in deep shade.

Trollius laxus Salisb. Alta, McDonald Lake, Mission Mts., Sperry Glacier, abundant at Gunsight Pass and Lake.

Aquilegia flavescens Wat. Bot. King 10 (1871). Yellow Columbine. Common in open, wet and springy but well drained places and rarely on slopes, alpine and subalpine, even to the top of MacDougal Peak. Sometimes pink, but not differing otherwise. Piper, Fl. Wash, 279, states that this species freely intergrades with A. formosa. The writer has seen no such intergrades, but they are to be expected as this species, A. formosa, and A. truncata, ar manifestly recent offshoots of A. Canadensis, from which they hardly deserve separation. Robinson has also fallen into the error of Watson (Bot. King 10) in the Synoptical Flora, 43, where he speaks of the "alpine smaller flowered form" as regarded as distinct by me. Watson's smaller flowered form, as shown by his own specimens, was not alpine, but was got low down in City Creek Canon near Salt Lake City, and is a well defined species which I have many times collected in the type locality. Watson's reference to its being alpine is evidently an error which Robinson has copied. The plant described by Watson looks more like a hybrid between A. coerulea and the "small flowered form" in Utah, where Watson got it. It is always alpine. But identically the same thing grows throughout Wyoming, Idaho and Montana in places where A. coerulea is not found and therefore cannot be a hybrid. This species can be instantly separated from all forms of A. formosa that I have seen by the short and hooked spurs, but in the north country it is sometimes with red sepals. McDonald Peak, also Columbia Falls (Williams). MacDougal Peak (Elrod, MacDougal and Umbach). Hall's

Peak (Miss Norton). Sperry Glacier (Umbach). McDonald Lake, Alta, Common. Lake McDonald to St. Mary's Lake, mostly alpine. Missoula.

Aquilegia formosa Fischer, is reported from all over the state but all forms so far seen are the above with tinged petals or sepals.

Aquilegia saximontana Rydberg. Gunsight Pass. This is nearer A. vulgaris, with glandular stems and pubescent fruit.

Aquilegia Jonesii Parry. Gunsight Pass.

Actaea spicata var. **rubra** Ait. Hort. Kew 2 221. A rubra (Ait) Willd. This includes the var, arguta which cannot be separated by any valuable character. A. eburnea Rydberg. Berries when red are indifferently spherical to oblong in the same spike which is oblong in fruit. Occasional in deep forests and along creeks in wet and springy places. Huckleberry spring, Schultze's cabin, the bog on the road to MacDougal Peak, Yellow Bay at creek, the Hemlocks, McDonald Peak, Hot Springs. Middle Temperate life zine. A form answering to var, arguta with white berries grows with the other but differs in no other way. These berries are almost always round, not so large, spikes elongating in fruit, leaves usually more cleft. MacDougal Peak, in the Mission Mountains, Common from Lake McDonald to St. Mary's Lake, Summit.

Aconitum Columbianum Nutt. Libby (Bailey).

Aconitum Columbianum var. **lutescens.** (Nelson Bot. Gaz., 41 54 1906, as species). Flowers constantly cream-colored. Alta, Lambert Valley. Not seen in the Sperry Glacier region.

Delphinium pauciflorum Nutt. MacDougal Peak, McDonald Lake Mission Mts., Blackfoot Glacier. Alpine.

Papaver nudicaule L. 507. Ours is the var. **arcticum** Elkan Mon. Pap. 16 (1839). Stanton Lake, Williams. Alpine. The published description of this species is not good. Stems from a densely leaved and few branched crown, and this from a slender and branching root. Leaves all radical, 5 cm. long, with blade 15-25 mm. long, broadly ovate, pinnately lobed with oblong-obovate apiculate and veiny lobes 2-5mm. long, thick, tips all with yellow needles and some on the face. Peduncles erect from a decumbent or curved base, 10 cm. long, slender, with stiff and yellow needles (not dark). Pods obovate-oval, more densely setose as well as the elliptical sepals, pods 15 mm. long.

Corydalis aurea Willd. Alta, McDonald Lake in the Mission Mts., Bigfork, (also by Elrod and Miss Norton).

Draba alpina I. Sperry Glacier.

Draba glacialis Adams. Sperry Glacier, Gunsight Pass.

Draba nemorosa L. Evaro, Missoula (Elrod).

Draba stenoloba Ledebour. MacDougal Peak, Sperry Glacier.

Draba crassifolia Graham. MacDougal Peak, Blackfoot and Sperry Glacier.

Lesquerella alpina Wat. Garrison. Probably also at Alta.

Lepidium apetalum Willd. Fort Missoula, Ravalli, Ronan, Alta. Missoula (Elrod).

Lepidium medium Greene. Common in fields.

Thlaspi alpestre L. Alta. Material gathered at Missoula by Elrod corresponds well with Watson's T. Californicum except that the radical leaves are wider and the pedicels indifferently spreading.

Thlaspi arvense L. Alta.

Capsella Bursa-pastoris (L) Medic. Common around dwellings.

Camelina sativa (L.) Crantz. Bigfork, Ronan.

Brassica arvensis (L.) BSP. A frequent weed in fields throughout the region.

Sisymbrium incisum Eng. var. **Hartwegianum** B. & W. Garrison.

Sisymbrium incisum var, **filipes** Gray. Evaro, Alta.

Sisymbrium canescens Nutt. Missoula (Elrod and MacDougal); Polson (Umbach).

Sisymbrium officinale (L.) Scop. St. Ignatius Mission.

Sisymbrium altissimum L. A very common weed in fields throughout.

Erysimum cheiranthoides L. Ravalli, Evaro, McDonald Lake in the Mission Mts. Missoula (Elrod).

Erysimum asperum DC. Bigfork. Garrison.

Radicula Nasturtium (L.) Britten & Rendle. Common in springs throughout.

Radicula obtusa (Nutt.) Greene. Common at Bigfork, Ronan, Alta, Ravalli. This is hardly a good species.

Radicula curvisiliqua (Hook.) Greene. Bigfork.

Radicula palustris (L.) Moench. Bigfork, Dayton, Alta.

Barbarea vulgaris var. **stricta** (And) Gray. Missoula, Swan Lake, Evaro.

Dentaria macrocarpa Nutt. The leaves are remarkably thick and leathery. Stems spreading and much branched below. Roots white and elongated. It does not grow near water. Flowers very variable in size. McDonald Peak in talus, also crevices of rocks at Lambert Valley. Not seen in the Sperry Glacier region.

Cardamine Breweri Wat. I can see no difference between this and C. vallicola Nelson. Alta. Also at Missoula by Elrod, Columbia Falls by Williams, and Mission Mts. by MacDougal.

Cardamine oligosperma Nutt. Bull Island, Bigfork, Hot Springs, Alta.

Cardamine Pennsylvanica Muhl. Bigfork, Polson Swamp, Alta, Swan Lake (Elrod).

Cardamine parviflora L. Bigfork, Ravalli.

Arabis Nuttallii Rob. Lambert Valley, Mission Mts., Blackfoot Glacier.

Arabis glabra (L.) Bernh. Bigfork, Yellow Bay, MacDougal Peak, McDonald Lake in the Mission Mountains, Alta, Ravalli, Ronan, Lambert Valley, McDonald Lake.

Arabis Holboellii Hornem. Alta to the British Boundary.

Arabis Holboellii var. **patula** Wat. Upper Marias Pass. Swan Mountains (Elrod).

Arabis suffrutescens Greene. MacDougal Peak, Blackfoot Glacier.

Arabis Drummondii Gray. McDonald Lake in th Mission Mts., Sperry to Blackfoot Glacier.

Cleome serrulata Pursh. Bigfork, Hot Springs, Ravalli, Ronan. Missoula (Elrod).

Drosera rotundifolia L. Swan Lake. Rost Lake (Miss Norton).

ELROD'S STONECROP.

Sedum Elrodi n. sp. Closely related to S. divergens. Densely tufted from horizontal and fleshy rootstocks. Perennial. Leaves ovate, sessile, the lower 2-5 mm. long, the uppermost oblong-ovate, not over 5-12 mm. long, obtuse smooth. Stems erect from a sometimes decumbent base, closely covered with the nearly imbricated thick and closely appressed leaves, sparingly branched above, ending in 1-2 scorpioid racemes not over 2.5 cm. long and few flowered. Flowers yellow, nearly sessile. Petals lanceolate-acuminate, 7 mm. long, twice as long as the stamens and four times as long as the ovate and obtuse sepals. Follicles united below and divaricate above. At Somers on loose soil and also on rocks in open places. Middle Temperate life zone.

Sedum stenopetalum Pursh. MacDougal and McDonald Peaks, Sperry to Blackfoot Glacier. This is S. subalpinum Blenkinship, but his characters do not hold.

Sedum Douglasii var. **uniflora** (Howell Fl. 213 (1898) as species). Upper Marias Pass.

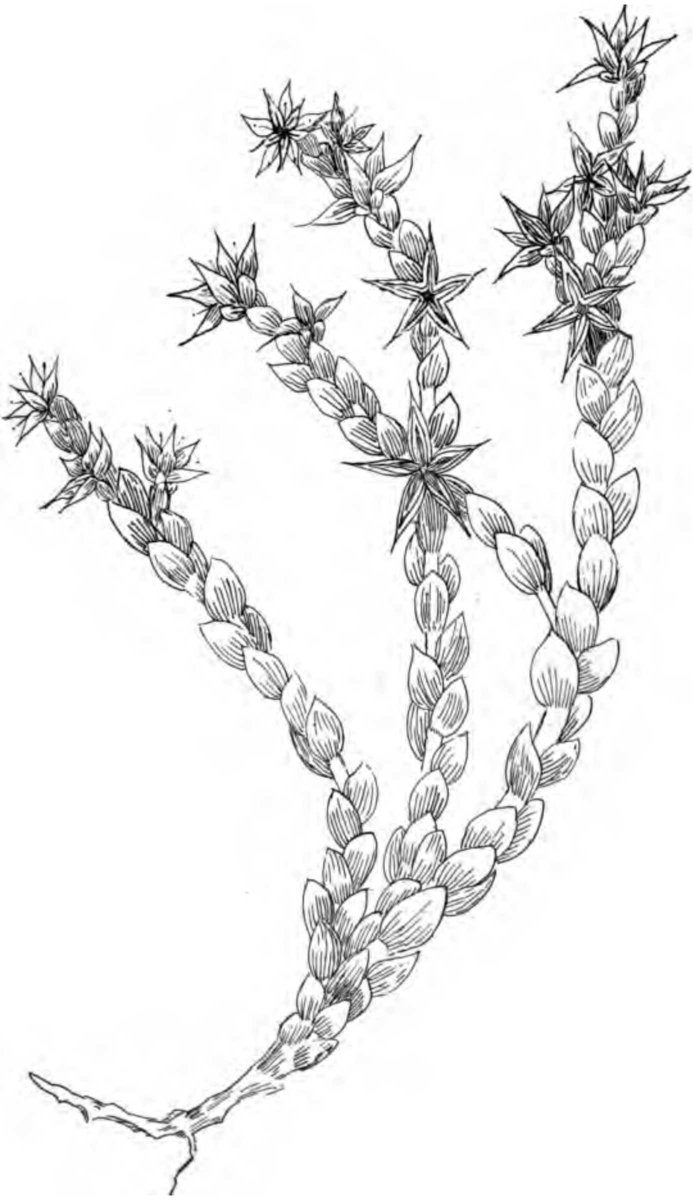
Sedum rhodanthum Gray. McDonald Peak, Sperry to Blackfoot Glacier, Lambert Valley, Upper Marias Pass. Mt. Lolo (Elrod).

Saxifraga oppositifolia L. Rare. Lambert Valley. Mission Mountains (Elrod).

Saxifraga adscendens L. MacDougal Peak.

Saxifraga chrysantha Gray. Mt. Lolo (Elrod).

PLATE IV.



SEDUM ELRODI JONES, N. S.

Saxifraga caespitosa L. Lambert Valley and Sperry Glacier.

Saxifraga rivularis L. Lambert Valley and Sperry Glacier, McDonald Lake in the Mission Mts.

Saxifraga debilis Eng. Reported from Sperry Glacier by Umbach, but may be the above.

Saxifraga cernua L. Lambert Valley.

Saxifraga Jamesii Torr. Mt. Lolo (Elrod). A very unexpected find. One would expect to find **S. heucheriforme** (Rydberg. Torr. Bull. 24 247 as Therofon) there instead.

Saxifraga arguta Don. MacDougal and McDonald Peaks, Yellow Bay, Alta. Common throughout the Mission and Swan Mountains at high elevations, and in the Sperry Glacier region. This is S. odontophylla Piper and S. punctata of recent authors. Piper is right in saying that the obovata-leaved S. punctata cannot be the same as this reniform leaved plant, but his name is preoccupied, and, in addition, S. arguta was well characterized by Hooker. It is easily separable from S. Nelsoniana by the clawed petals, as Piper has said, the latter being a Pacific Coast plant.

Saxifraga Mertensiana Bong. Darby at Como Peak, Sperry to Blackfoot Glacier.

Saxifraga stellaris L., S. Nutkana Moq., S. Bongardi Presl. There is a slight difference between this and S. stellaris, but that seems to be a very variable species. Common in the Sperry Glacier region. Leaves very variable.

Saxifraga reflexa Hook. McDonald Lake in the Mission Mountains, Sperry Glacier.

Saxifraga occidentalis Wat., Micranthes Alleni and aequidentata Small. Petals either entire or notched in the same flower, and either clavate or filiform also. MacDougal Peak, McDonald Lake in the Mission Mountains, Sperry to Blackfoot Glacier. Elrod Peak and Missoula (Elrod).

Saxifraga Oregana Howell., S. Sierrae Coville. This is the western representative of S. Pennsylvanica but with broader petals. The typical form has large and conspicuous petals, but they vary greatly down to S. Sierrae, and probably includes also S. Montanensis Small. It is a very robust plant. Mt. Haggin.

Saxifraga integrifolia Hook. This abounds in alpine places to the south of our region and adjoining it, but farther south passes by imperceptible degrees into

Saxifraga integrifolia var. **rhomboidea** (Green Pitt., 3. 343 as species). This is reported from Missoula and Deer Lodge. It grows at Lima. This again varies into

Saxifraga integrifolia var, **apetala** (Piper Torr. Bull. 27 393 as species).

Leptarrhena amplexifolia (Sternb.) Seringe. Sperry to Blackfoot Glacier. This grows in large patches from underground stems. Leaves waxy-green above and white below.

Boykinia major Gray. Hamilton.

Heuchera parvifolia var. **dissecta**. Leaves 5-7-lobed to or below the middle. Petals double the calyx lobes. Anaconda and Durant.

Heuchera cylindrica Dougl. Wheelock is certainly justified in putting all the variant forms into one species as there is a complete transition through all. This replaces S. rubescens on cliffs, which species abounds to the south in drier situations. The typical form with long red hairs on the petioles not yet found in our region.

Heuchera cylindrica var. **glabella** (T. & G.) Wheelock. Bull Island, Missoula, Bigfork, Coeur d'Alene Lake, Ravalli, Alta. Also gathered by all previous collectors.

Heuchera cylindrica var. **ovalifolia** (Nutt.) Wheelock. Lambert Valley Upper Marias Pass, Lake McDonald to St. Mary's in the Sperry Glacier region. Alpine.

Heuchera cylindrica var. **tenuifolia** Wheelock. MacDougal Peak.

Heuchera Hallii var. **grossulariifolia** (Rydberg Fl. Mont. 196 as species) Ryan's Lake and Mt. Haggin, both bordering on Deer Lodge Valley. Also at Ketchum, Idaho (Mrs. Brodhead).

Heuchera Williamsii Eaton. This both Greene and Rydberg put into Tellima (Lithophragma) because it has a turbinate calyx anu racemose habit, while they ignore the far more important heucheriod leaves, roots and five stamens, which clearly place it in Heuchera. Lima, probably not in our region.

Mitella trifida Graham. Bigfork, Alta, McDonald Lake in the Mission Mountains. Also Missoula by Elrod and MacDougal.

Mitella trifida var. **stauropetala** (Piper Erythea 7 161 as species.) Coeur d'Alene Lake, Deer Lake in Southern Idaho. Baker's number 263 from Mt. Hesperus, Colorado, is the same. This is a form with long and filiform lobes. Greene (Pitt. 1 32), Rydberg (Fl. Mont.), and Piper (Erythea 7), have split this species up into several unwarranted species, based on the development of lobes in the petals, but there is every gradation in length and width from rudimentary to long and filiform lobes. Greene's species is M. diversifolia, Rydberg's M. violacea, and Piper's M. stauropetala and stenopetala and var. Parryi.

Mitella Breweri Gray. Common on MacDougal Peak.

Mitella pentandra Hook. Common on all the high peaks from Alta northward.

Mitella nuda L. Frequent in dark woods from McDonald Lake in the Mission Mountains to the Boundary.

Tellima tenella (Nutt.) Walp. Missoula (Elrod); Columbia Falls (Williams).

Tellima glabra (Nutt.) Steud. Bigfork (Elrod); with short pedicels. Columbia Falls (Williams) with pedicels over half an inch long.

Tellima parviflora (Nutt.) Hook. Missoula (Elrod and MacDougal), Columbia Falls (Williams).

Tiarella trifoliata L. Bigfork, very rare. It was sought constantly throughout the region from Alta to Blackfoot Glacier this year but none could be found, while T. unifoliata was everywhere.

Parnassia parviflora DC. Swan Lake. All forms reported as P. palustris from this region are of this species. The Dissection of the staminodia amounts to but little.

Ribes Hudsonianum Rich., R. petiolare Douglas. There is no permanency in the characters of R. petiolare. Its leaves are normally much larger and longer petioled, but all sorts of intergrades occur, Alta, Hamilton, Anaconda and Mt. Haggin.

Ribes Howellii Greene. Its character of drooping short and few flowered racemes seems to hold, the others do not. St. Ignatius Mission in deep and dark willow swamps.

Ribes viscosissimum Pursh. Frequent in all the mountains from Alta northward.

Ribes cereum Dougl. Common in all the mountains from Alta northward.

Ribes lacustre (Pers.) Poir. Frequent at all elevations but most common at low elevations from Alta northward to the Boundary. The typical form has black fruit, slender racemes, and only lobed leaves.

Ribes lacustre var. **parvulum** Gray. This has leaves lobed nearly to the base and smooth, rarely over an inch wide, hardly deserves varietal rank. Hamilton, Anaconda, Alta.

Ribes lacustre var. **lentum** Jones, R. lacustre var. molle Gray. This is very pubescent and glutinous all over, with small and much dissected leaves often only half an inch wide. It is strikingly different from the type and grows in alpine places only and usually has red fruit, though not always. The type and var. parvulum have black fruit normally but often red when immature. Alta, Como Peak.

Ribes oxyacanthoides L. The typical form does not seem to grow in the west.

Ribes oxyanthoides var. **saxosum** (Lindl.) Colville, R. inerme Rydberg, R. vallicola Greene. This is the common smooth gooseberry of the streams, growing under willows at low elevations. Missoula. The form corresponding to R. imerme, with long peduncle, grows at Lima and St. Ignatius Mission. The ripe fruit is very palatable. Belton, Below Gunsight Lake, Mission Creek, Monida.

Ribes setosum Lindl. Anaconda, Ravalli, Alta, McDonald Lake in the Mission Mountains.

Ribes irriguum Dougl. Fruit sometimes with a few scattered prickles and sometimes white. Probably this and R. setosum are not distinct. The plants that correspond to R. setosum are nearly smooth but with distinct cylindrical calyx, short peduncles, and sometimes is very setose, the species (R. setosum) is described as pubescent and very setose. What corresponds to R. irriguum has softly pubescent leaves and evident peduncles, and campanulate calyx. Bigfork, Yellow Bay, St. Ignatius Mission, MacDougal and McDonald Peaks, Bull Island, Dayton, Hot Springs, Missoula, Ravalli. Also Missoula (Elrod). I fail to see any good character to separate Green's R. cognatum or Blankinship's R. camporum.

Potentilla Monspeliensis L. Rexford and Whitfish, Ravalli, Upper Marias Pass. At the following places are the var. Norvegica, Bigfork, Daphnia Lake, Schultze's cabin.

Potentilla argentea L. Whitfish, apparently introduced.

Potentilla dissecta Pursh. MacDougal and McDonald Peaks, Lambert Valley, Sperry Glacier.

Potentilla dissecta var. **glaucophylla** (Lehm.) Wat. MacDougal Peak Same locality by Miss Norton and Umbach.

Potentilla decurrens (Wat.) Rydberg. Blackfoot Glacier.

Potentilla gracilis Dougl. Wild Horse Island.

Potentilla Blaschkeana Turcz. Alta, Ronan, Upper Marias Pass, Swan Lake by Elrod. A doubtful species.

Potentilla Nuttallii Lehm. Also a doubtful species. Alta, Monida. Missoula and St. Ignatius Mission (Elrod).

Potentilla ctenophora Rydberg. Monida, Missoula by Elrod.

Potentilla flabellifolia Hook. Ronan.

Potentilla Pennsylvanica L. Garrison and Lima.

Potentilla Hippiana Lehm. Browning.

Potentilla Anserina L. Frequent at low elevations throughout.

Potentilla pseudorupestris Rydberg. This probably includes convallaria. On all the high peaks from Alta northward. The convallaria form at Garrison.

Potentilla glutinosa Nutt. Alta to Bigfork on prairies and rocky Hillsides at low elevations. This may include P. Wrangeliana which was found at Alta.

Potentilla palustris (L.) Scop. Common in swamps at low elevations from Alta northward.

Geum ciliatum Pursh. Common in meadows at low elevations from Alta northward.

Geun rivale L. Bigfork, Below Gunsight Lake. Also Missoula (Elrod) and Rost Lake (MacDougal).

Geum strictum Soland. Ravalli.

Geum macrophyllum Willd. Common from Alta northward.

Purshia tridentata (Pursh) DC. Common on the western side of Flathead Lake, also on McDonald Peak.

Dryas Drummondii Rich. This seems to be rare. McDonald Peak and Blackfoot Glacier, alpine. The other species is very common.

Cercacarpus ledifolius Nutt. Alta. This has the habit of the var, intricatus but the leaves are nearer typical.

Fragaria bracteata Heller. Alta, McDonald Lake in the Mission Mountains.

Fragaria platypetala Rydberg. Bigfork, McDonald Lake in the Mission Mountains. Lake McDonald to St. Mary's Lake. The species of strawberry are in a state of confusion.

Rubus pedatus Smith. Bigfork. Rost Lake by MacDougal and Miss Norton. Columbia Falls by Williams.

Rubus parviflorus Nutt., R. Nutkanus Moq. Very common from Alta northward.

Rubus Idaeus var. **acutissimus** Reg. & Lndl. R. strigosus Mx. This variety has very hispid pedicels, short-petioled leaves, coarsely serrate and wide, fruit nearly double the size of the prevailing western plant. Ravalli, McDonald Lake in the Mission Mountains.

Rubus Idaeus var. **gracilipes.** Leaves long-petioled; leaflets mostly narrowly ovate, not coarsely serrate; pedicels nearly smooth, sepals barely tailed; fruit rarely over half an inch long; flowers small. Very common from Alta northward, and throughout the west. R. nivalis reported by Watson from the Bitter Root Valley is almost certainly a depauperate form of this species and not the true R. nivalis.

Sanguisorba annua Nutt. Common on the Flathead plains, Ravalli, Ronan, Evaro.

Rosa Nutkana Presl. St. Ignatius Mission, Browning.

Rosa Nutkana var. **MacDougali** (Holzinger Bot. Gaz. 21 36 as species). Alta, Mission Creek, common throughout the Flathead region.

Rosa pisocarpa Gray. Common in open and dry woods from Alta northward.

Prunus Americana Marsh. This has become established at Ravalli and in the Bitter Root valley.

Prunus emarginata (Dougl.) Walp. Common throughout the region from Mission Creek northward but not seen in the Sperry Glacier region though found at Belton and Upper Marias Pass.

Prunus mollis (Dougl.) Walp. Sand Point, Idaho. Libby (Bailey). Reported from Ravalli by MacDougal and Butler but diligent search fails to reveal it there. This is considered to be a variety of P. emarginata but I have seen no intergrades.

Prunus demissa (Nutt.)Dietr. I fail to see any ground for Nelson's P. melanocarpa, even though Nuttall describes his as red fruited, for we know that this species has fruit red till dead ripe when it turns black. Common everywhere at low elevations.

Spiraea Douglasii Hook. Alta, Sand Point, Idaho. Silloway Peak, MacDougal, Elrod Peak (Elrod), Lolo (Watson).

Spiraea Douglasii var. **Menzissii** (Hook.) Presl. Libby (Bailey).

Spirea densiflora Nutt. Bigfork, MacDougal Peak, Sperry Glacier to Gunsight Lake.

Spiraea corymbosa Raf. Common from Alta northward.

Physocarpa opulifolia var. **pauciflora** (T. & G.) Piper. Very common throughout.

Crataegus Douglasii Lindl., Bot. Reg. 21 to 1810 (1836). C. rivularis Nutt. Douglas's Hawthorne. Fruit red till near maturity. This can always be separated from the other species by the small spines, never branched, and by the narrow and less lobed leaves, and the open and less scraggy habit. It is much infested with a fungus, Roestelia. Very common along creeks and on the lake shores. Fruit more juicy than the red one. The bark is all smooth and gray except on large trunks below, where it flakes up some. It is a slender and opened branched shrub 15-30° high. Fruit blue-black, oval. Common in all localities except on the mountains, also at Whitefish, Rexford and Sand Point, Idaho. Missoula (MacDougal), and Bigfork (Umbach), both as C. brevispina. Middle Temperate life. Belton, Ravalli, Ronan, McDonald Peak.

Crataegus Columbiana Howell, Fl. 163 (1898). Columbian Hawthorne. This has gone under the name of C. occidentalis Britton and C. macracantha Lodd. as well as C. coccinea, and in all probability one name is as good as the other. There is no warrant whatever for the infinitessimal subdivision of Crataegus as is done by Sargent, Ashe, Britton, Rydberg and others. It can end only in making a species out of almost every sheet of specimens. Crataegus is remarkably sensitive to soil and drainage, like Amelanchier, and its leaves respond at once to varying conditions by their size and the amount of dissection of the margin as well as by the thickness. Another element of confusion lies in the fruit being red when immature in both species, turning black only at the last moment in C. Douglasii, and if specimens are taken by the grab sample way in which most are taken there is no reliance to be placed on the color. The only safe guide seems to be in the relation of the spines and leaves to each other. When the leaves are narrow and little dissected the spines are often slender. This is particularly true of the forms in the interior to which Greene has given the name salicifolia. The red fruited species in our region is common along creeks in the same situations as the other, and along the lake shore. When starved the leaves are small and the fruits few, but the bushes are very scraggly and thorny with generally branched thorns twice to four times as long as in the other species. Leaves normally much wider and more cut. The upper bark is smooth and gray, the lower bark rough in flakes. Fruit often as wide as long and sometimes yellow in trees growing side by side, and nearly always shorter and wider than in the other species. It is a pretty tree in the fall with its red fruit. Polson, Bigfork, St. Ignatius Mission, Wild Horse Island, Dayton, Hot Springs, where it is more abundant than the other. Wild Horse Island (Elrod), Rost Creek (MacDougal), Polson (Umbach, as C. occidentalis). Middle Temperate life zone. Some trees were completely covered by the red fungus Roestelia. No Crataegus in the Sperry Glacier region.

20. AMELANCHIER. SERVICE BERRY.

Amelanchier alnifolia Nutt. Gen. 1 306 (1818), and Jour. Phil. Acad. 7 22 (1834). This is the most sensitive to climatic differences of any species in the family. The humid regions have large and thin leaves with many teeth, long petals and racemose inflorescence, and fruit often half an inch wide. The most arid and hot regions have the leaves often not over half an inch long and nearly circular, and with few teeth, very thick and leathery, short petioles and raceme often reduced to a single pedicel, but in all this variance there is not a single permanent specific character. Our forms come near to those described as C. Cusickii Fernald with oval and subcordate leaves and long petals nearly an inch long. Fruit either one to few in a place or racemose, small or large, juicy or not. Common in dry places. Bigfork, Yellow Bay, on all the islands, Dayton, St. Ignatius Mission, McDonald Peak, Hot Springs. Elrod Peak (Elrod) and Wild Horse Island. Missoula (MacDougal and Elrod). Mission Creek, Lake McDonald to St, Mary's Lake, but not so common because of too much humidity, Ravalli, Ronan, Alta, McDonald Lake in the Mission Mountains.

Amelanchier alnifolia var. **Utahensis** (Koehne) Jones, is reported by both Piper and Rydberg from Washington and Montana but it does not grow in either state. Its habitat is on the edge of the Tropical life zone, under wholly different climatic conditions. The type of this variety is in my own herbarium collected by myself.

Pyrus Americana (Marsh) DC. Frequent from Alta northward.

Pyrus Sitchensis (Roem.) Piper. Blackfoot Glacier, Yellow Bay. There is doubt of the validity of this species.

Lupinus sericeus Pursh. Common in open pine woods from Alta northward.

Lupinus ornatus Dougl. Bigfork, Daphnia Lake, Wild Horse Island, Ravalli, Ronan. The var. bracteatus collected at Missoula by MacDougal and at Wild Horse Island by Elrod.

Lupinus alpicola Hend. Common in subalpine burns. MacDougal Peak, also at Belton and Evaro. Doubtfully distinct from L. sericeus.

Lupinus laxiflorus Dougl. Alta, Monida. Also Missoula and Bigfork (Elrod). No lupines seen in the Sperry Glacier region.

Trifolium hybridum L. Alta.

Trifolium pratense L. Bigfork, Polson, Alta, Ronan.

Trifolium longipes Nutt., T. Rydbergii Greene, T. latifolium Greene, T. caurinum Piper, are forms. Evaro, Alta, McDonald Lake in the Mission Mountains. No clovers seen in the Sperry Glacier region.

Medicago Lupulina L. Ravalli.

Glycyrrhiza lepidota Nutt. Frequent along lake shores and streams from Alta northward.

Astragalus decumbens (Nutt.) Gray. This grades into a multitude of forms, according to the shade and soil in which it grows. A. decumbens var. campestris (Gray) Jones is an extreme form, with wide leaves and ascending habit. Other synonyms are A. convallarius Greene, Homalobus hylophilus Rydberg, etc. Wild Horse Island, Rexford, Alta. MacDougal Peak (Miss Norton).

Astragalus pectinatus (Hook.) Douglas. Browning.

Astragalus leptaleus Gray. Big Arm, Monida, Somers. Wild Horse Island (Elrod), MacDougal Peak (Miss Norton).

Astragalus miser (Dougl.) Gray. Garrison, Upper Marias Pass.

Astragalus Bourgovii Gray. Common on all the peaks from Lambert Valley to the Blackfoot Glacier.

Astragalus alpinus L. Alta, Echo Lake. Reported from several other localities but probably confounded with A. Bourgovii.

Astragalus elegans Hook., A. eucosmus Rob. Supposed to grow at Upper Marias Pass, but probably confounded with A. Bourgovii.

Astragalus aboriginum var. **glabriusculus** (Gray.) Jones. Upper Marias Pass.

Astragalus Americanus (Hook.) Jones. Alta.

Astragalus Drummondii Dougl. Garrison, Missoula (MacDougal).

Astragalus agrestis Dougl. Evaro, Ronan, Missoula (MacDougal).

Astragalus nitidus Dougl. Browning.

Astragalus Canadensis var. **Mortoni** (Nutt.) Wat. Occasional from Alta northward in open woods and fields.

Astragalus Purshii Dougl. Missoula (Elrod).

Astragalus inflexus Dougl. Wild Horse Island, Missoula. Also at Missoula by Elrod and MacDougal.

Astragalus crassicarpus Nutt., A. prunifer Rydberg. Garrison and Browning.

Astragalus arrectus Gray., A. Kelseyi Rydberg. Deer Lodge Valley.

Astragalus flexuosus Dougl. Browning.

Oxytropis deflexa DC. Blackfoot Glacier, Mt. Hagin, Browning.

Oxytropis alpicola (Rydberg Fl. Mont, 252 as Aragallus). Blackfoot Glacier, Mt. Haggin.

Oxytropis monticola Gray. Deer Lodge Valley, Echo Lake, MacDougal Peak (Elrod and MacDougal).

Oxytropis Lamberti var. **ochroleuca** Nelson. There is no character that separates this from O. Lamberti but the color of the flowers. There is no character that separates it from O. monticola but the appressed calyx hairs. Normally the flowers are an inch long and the pod a trifle stiffer than in O. monticola, and less inflated, but these characters vary greatly. No specimens of this variety have as yet been reported from our drainage but it is common eastward and southward. The low and single stemmed plant of the plains seems abundantly distinct but unfortunately it passes by imperceptible gradations into the tufted froms with purple flower and exactly like this variety except the color of the flowers.

Oxytropis gracilis (Nelson Erythea 7 60 as Aragallus). Upper Marias Pass.

Oxytropis nana Nutt. Garrison.

Oxytropis splendens Dougl. Upper Marias Pass, Browning.

Oxytropis viscida Nutt. in T. & G. Fl. 1 341 (1850), Aragallus viscidus (Nutt.) Greene, Aragallus viscidulus Rydberg. Viscid Oxytropis. Rydberg's attempt to elucidate this species in the Flora of Montana has only added to the confusion, while his additional species has no foundation. He refers Nuttall's type to Oregon when it must have been collected either in Montana or Idaho. Nuttall gives it as on the "Headwaters of the Oregon," but the "Oregon" does not head in Oregon. Rydberg gives it as growing at 4000 to 8000 feet on hills when it is seldom found lower than 9000 feet, and then on rocky ridges in subalpine places. Watson's locality was 10,000 feet elevation. In his A. viscidulus Rydberg gives the habitat as dry hills and mountain sides when it is always high alpine or subalpine, from timberline (11,500 feet altitude in Utah) to 10,000 feet altitude on rocky ridges. His characterization of both species is equally erroneous. He says O. viscida always has yellow hairs at base of stems, when they are nearly always white as in the other. He says the hairs on stem, calyx and pods are white and never black in O. viscida while they are both, or in some cases wholly absent. One can always find black hairs underneath the shaggy white ones in O. viscida, as the shaggy ones get less the black ones become more evident. In O. viscidula the pubescence varies likewise, but the black hairs ar more evident and the shaggy ones only occasionally in evidence. In my specimens from Mt. Haggin in Deer Lodge Valley near timber line there is no pubescence on the calyx at all except the always present stipitate yellow glands which are very abundant, the specimens are depauperate and the old pods broadly oblong and obliquely short-apiculate, and about 1 cm. long. In my material from Ryan's Lake, same valley, near timber line the calyx is shaggy with white and black hairs intermixed. In my material from Lima, doubtless the same locality where Rydberg got his, the calyx is loosely shaggy with black hairs as well as the pods, and in specimens got close by the calyx is shaggy with white hairs, with a few black ones underneath. The pods vary from oblong-ovate and short-acuminate to lanceolate-acuminate, and from long-beaked to apiculate in pods from the same tuft, and from a half inch long to an inch long, with divergent beak. It is evident that Nuttall's original was a depauperate plant with slightly developed pods. In all my material, of which I have much, my field notes say the flowers are bright red, in drying they turn to blue, or when not quickly dried turn white, and this is probably the reason why Nuttall's specimens seem white flowered. This should grow on all our high peaks. Rydberg refers Watson's material from the East Humboldt Mts. Nevada, to O. viscida and mine from the Wasatch to O. viscidula, while they are the same, as I have material from both localities. This plant also grows at Browning on gravelly knolls.

Hedysarum boreale Nutt., H. Americanum (Mx.) Britt., H. lancifolium Rydberg. Common on the high peaks from Como Peak to Upper Marias Pass.

Hedysarum sulphurescens Rydberg. Common on the high peaks from McDonald Peak north and east.

Linum Lewisii Pursh. Frequent on prairies and in open woods throughout.

Geranium incisum Nutt. Common from Alta northward.

Geranium Carolinianum L. Frequent in fields and waste places. Bigfork, St. Ignatius Mission, Whitefish, Ravalli.

Geranium Carolinianum var. longipes Wat., G. Bicknellii Britton. This grows with the type. Ravalli, Alta, Bigfork.

Erodium cicutarium L'Her. Missoula (MacDougal).

Euphorbia glytosperma Eng. St. Ignatius Mission, Ravalli, Belton, Columbia Falls.

Euphorbia dictyosperma F. & M. Ravalli.

Callitriche palustris L. Bigfork, Ravalli, Alta, Darby, Browning.

Callitriche autumnalis L. Ronan, Evaro.

Rhus glabra L. Ravalli.

Rhus Toxicodendron L., R. Rydbergii Small. Frequent among rocks in all localities at low elevations.

Impatiens biflora Walt. Common in swamps at St. Ignatius Mission, Hot Springs, Ravalli, Sand Point (Idaho) and Bigfork, where it is in the latter place wholly cleistogamous.

Impatiens biflora var. **ecalcarata** Blankinship (Mont. Ag. Coll. Stud. 1 85 as species). This is simply a spurless form and grows along with the type. Also Swan Lake (Miss Norton).

Rhamnus Purshiana DC. Bigfork, Ravalli.

Ceanothus velutinus Dougl. MacDougal and McDonald Peaks, Upper Marias Pass.

Glossopetalon spinescens Gray. Alta.

Ampelopsis quinquefolia (L.) Mx., Parthenocissus—(L.) Planch, etc. Swan Lake, introduced.

Malvastrum coccineum (Pursh) Gray. Bitter Root and Deer Lodge Valleys, Browning.

Malva rotundifolia L. St. Ignatius Mission.

Sidalcea Oregana Gray. Ronan.

Hypericum Canadense var. **boreale** Britton. Polson Swamp, Bigfork.

Hypericum formosum HBK. Common from Ravalli to Blackfoot Glacier and St. Mary's Lake.

Hypericum Nortonae, n. sp. Miss Norton's St. John's Wort. Stems about 10 cm. long, erect from slender underground rootstocks, barely angled, simple. Leaves rather congested, nearly round to oval-ovate, obtuse, thick and scarcely at all black-punctate 1.5-2.2 cm. long, cordate, sessile, not clasping. Flowers 1-3, terminal, on a short, 2-bracted pedicels. Sepals ovate, obtuse, about 2.5 mm. long, greenish with purplish tips. Petals rather narrow strongly-many-nerved, yellow, 1-1.5 cm. long. Stamens many. Styles 3, long, distinct. Pods ovate, 3-lobed at tip. It is evidently allied to H. formosum. Alpine in moist places. McDonald Peak, Elrod Peak (Elrod). Dedicated to Miss Gertrude Norton, who has worked long on the flora of this region. Upper Marias Pass, Sperry Glacier, Lambert Valley. It shows no variation toward H. formosum.

Elatine Americana Arn. Common throughout the Flathead Valley.

Elatine brachysperma Gray. Alta.

Viola nephrophylla Greene. Bigfork, Swan Lake, Polson, Rost Lake, Wild Horse Island. Common.

Viola Canadensis L. Bigfork, Swan Lake, Rost Lake, McDonald Lake in the Mission Mountains, Blackfoot Glacier. Also gathered by all previous collectors.

Viola glabella Nutt. MacDougal Peak, Bigfork, Wild Horse Island.

Viola venosa (Wat.) Piper. Bigfork (Elrod).

Viola sarmentosa Dougl. McDonald Peak and Lake.

Viola sarmentosa var. orbiculata (Geyer) Gray. Bigfork, Yellow Bay, Belton.

Mentzelia laevicaulis (Dougl.) T. & G. Garrison.

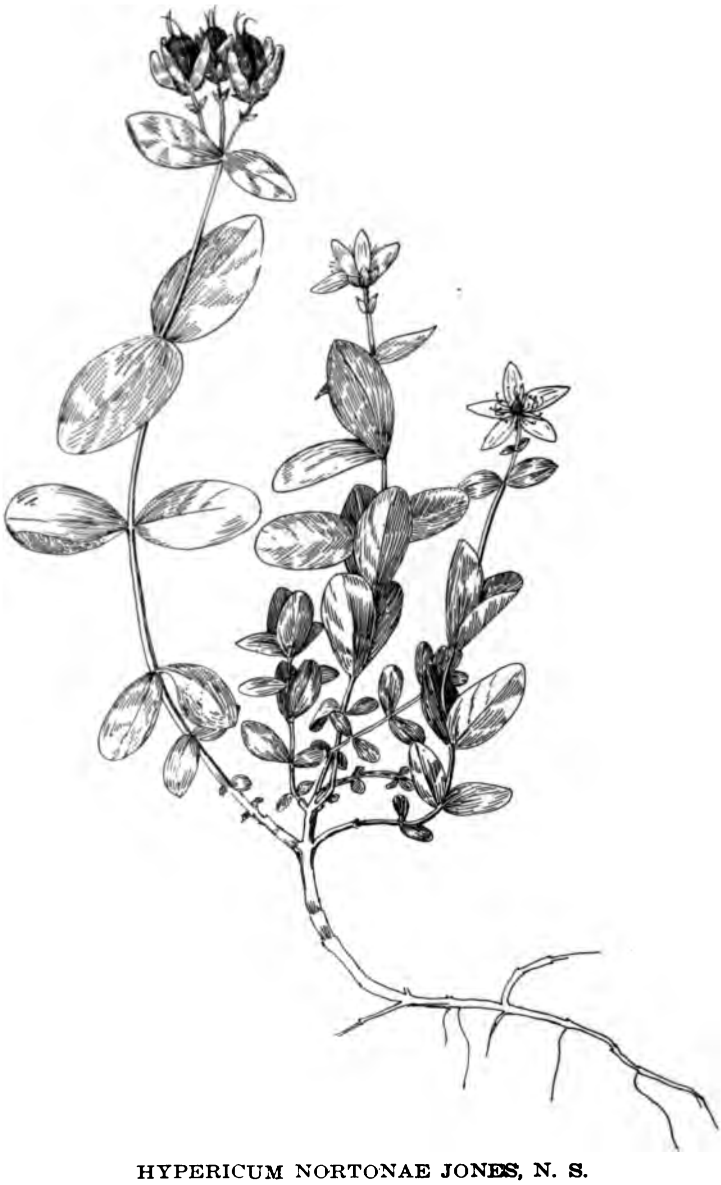
Opuntia polyacantha Haw. Garrison, Browning.

Circaea alpina L. Common in damp and deep woods from the Mission Mountains northward.

Circaea alpina var. **Pacifica** (Asch. & Mag. Bot. Zeit. 29 392 as species). This has deeper toothed leaves and normally minute bracts on the racemes but there are all sorts of intergrades. Yellow Bay.

Gaura coccinea Pursh. Ravalli, Browning.

PLATE V.



HYPERICUM NORTONAE JONES, N. S.

Oenothera biennis L. Polson, Ravalli, Browning.

Gayophytum caesium (Nutt.) T. & G. Alta.

Gayophytum ramosissimum (Nutt.) T. & G. Alta, Garrison.

Gayophytum diffusum (Nutt.) T. & G. Hot Springs.

Gayophytum lasiospermum Greene. Darby.

Epilobium augustifolium L. Common from Alta northward.

Epilobium latifolium L. MacDougal Peak, Gunsight Pass, Blackfoot Glacier, Upper Marias Pass.

Epilobium minutum Lindl. Mission Creek.

Epilobium palustre L. Polson Swamp.

Epilobium adenocaulon Hausskn. Common from Alta northward at low elevations.

Epilobium alpinum L. MacDougal and McDonald Peaks, Upper Marias Pass.

Epilobium Hornemanni Reich. This is a very doubtful species as it seems to intergrade with E. alpinum. Common on all the high peaks from Alta northward.

Epilobium clavatum Trelease. A very doubtful species. MacDougal Peak (Elrod and Umbach).

Epilobium glandulosum Lehm. Swan Lake.

Hippuris vulgaris L. Common in swamps throughout.

Myriophyllum spicatum L. Dayton, Bigfork.

Myriophyllum hippuroides Nutt. Common at Bigfork.

Myriophyllum verticillatum L. Common on the shores of Flathead Lake, Swan Lake, Daphina and Rost Lakes, Dayton, Whitefish.

Cogswellia macrocarpa (Nutt.) Jones. Common on dry prairies from Missoula northward.

Cogswellia simplex (Nutt. Bot. King 129 as Peucedanum). Common from Alta northward.

Cogswellia Altensis, n. sp. Allied to C. simplex. Stems several from a fleshy, elongated, not tuberous root, dark-green, 7-15 cm. long, erect. Whole plant smooth. Leaves biternate, with short root petioles and vaginate stem ones. Leaflets nearly filiform, falcate, acute, 5-8 cm. long, entire. Peduncles slender, about 1.5 dm. long. Rays very unequal, from 1.5-5 cm. long, slender, 3-6. Involucels of few needle-like bracts. Pedicels 2.5-7.5 mn. long, slender. Fruit about 7 mm. wide and 12 mm. long, oblong-obovate, the wings as wide as the body. Oil tubes solitary and large. Ribs evident and raised. Oil tubes on commissure threadlike, one on each side of the midnerve, and with another running down half way outside of it. Seed nearly flat and with linear cross section. Wings thickest at inner edge where they are about half as thick as the body of the seed. Alta, under pines on the upper edge of the Middle Temperate life zone, on dry south slopes.

Cogswellia Sandbergii (C. & R.) Jones. Subalpine on MacDougal Peak, also at Lake Louise near Sperry Glacier. This cannot be located in Coulter and Rose's Monograph because it is placed under "glabrous throughout" in the key, while the fruit is puberulent.

Cogswellia ambigua (Nutt.) Jones. Mission Creek.

Cogswellia montana (C. & R.) Jones. Missoula (Elrod).

Angelica Roseana Hend. Mission Creek and McDonald Peak.

Leptotaenia multifida Nutt. Common in all the mountains to the alpine.

Peptotaenia multifida var. Eatoni (C. & R.) Jones. MacDougal Peak, Alta. This includes L. filicina Jones probably.

Heraclueum lanatum Mx. Common from Alta northward.

Ligusticum tenuifolium C. & R. Alta.

Ligusticum Leibergi C. & R. Alta.

Cymopterus Elrodi n. sp. Habit of C. thapsoides. Shortly caulescent and densely branched from a woody root. Stems ascending, stout, 5-10 cm. long. Peduncles 3 dm. long. Leaves with stout petioles longer than the blades, blades ovate to deltoid in outline, ternately and then pinnately decompound, 1 dm. long, with filiform and aculeate and rigid but smooth segments about 2.5 mm. long. Rays about 10, unequal, 1.5-5 cm. long, stout. Slender pedicels about 10 cm. long. Bractlets needle-like and short. Fruit about 9 mm long and half as wide, elliptical, truncate at tip and slightly emarginate at base. Lateral wings not over .6 mm. wide, dorsal reduced to raised ribs and with one or two of them slightly winged. Oil tubes about 5 in the intervals and 14 on the commissure. Seed face concave. This is nearest to C. thapsoides but the seed is twice as long and with mostly abortive wings. Alta, Mont. In the canyon of the Bitter Root River among loose rocks and gravel on dry knolls. July 11, 1909.

Musenium Hookeri Nutt. Garrison.

Bupleurum Americanum C. & R. Browning on the plains. Blankinship's B. purpureum is only an alpine form. Mt. Haggin and Lima.

Zizia cordata (Walt.) Koch. Browning.

Carum Gairdneri (H. & A.) Gray. Common from Alta northward.

Cicuta bulifera L. Swan Lake in swamp on decaying logs. Lake McDonald (Williams and Umbach).

Cicuta Douglasii (DC.) C. & R., C. vagans Greene. Browning, Ravalli.

Cicuta Douglassi var. **occidentalis** (Greene Pitt. 2 7 as species). This is the common form of the Great Plateau, with oval to elliptical fruit about 3 mm. long. Coulter and Rose say of this group "fruit oblong" while none of them are narrower than oval or elliptical, their own figure on p. 94 being oval or elliptical. In my specimens No. 1909 from Salt Lake City referred here by them the fruit is from depressed-orbicular to orbicular-ovate, and runs about 2 mm. long. They also say of the vagans group "fruit orbicular, oil tubes very narrow" while in fact they are very broad as often as narrow. St. Ignatius Mission.

Berula erecta (Huds.) Coville. Common all around Flathead Lake, Ronan, St. Ignatius Mission.

Sium cicutaefolium Gmel. Common in shallow water in all localities.

Osmorhiza divaricata Nutt. Coulter and Rose in their last monograph attempt to split up the species of this genus on the constriction of the tip of the fruit. An extensive examination of material shows that this is fallacious and their species invalid. This species includes Washingtonia Leibergi and brevipes. Leibergi forms are from MacDougal Peak and Blackfoot Glacier in the collection under consideration. Other forms are from the East Humboldt Mountains, Nevada, and Diamond Peak, Calif. My divaricata forms are from Ravalli and Bigfork, my brevipes forms from Bigfork and MacDougal Peak along with the others and growing under the same conditions.

Osmorhiza divaricata var. **nuda** (Torr. Pac. R. R. Rep. 4 93 as species). Washingtonia nuda and obtusa. Alta and MacDougal Peak. The Alta specimens have the leaflets of brevipes, but more acute, pedicels and peduncles very divaricate, fruit clavate, the body 10 mm. long, triangular-acute, beak .5-2.5 mm. long, stylopodium mostly wider than high and minute, pedicels longer than the fruit, leaflets 3-4 cm. long. Nelson's No. 4997 from Wallace Creek, Wyo., has the fruit peduncles and pedicels the same but fruit narrower and beak .5 mm. long and leaflets often 5.5 cm. long. My specimens from Payette Lake, Idaho, July 24, 1899, referred by Coulter and Rose to brevipes, are exactly obtusa in every particular, with the minute stylopodium and triangular-acute beakless tip, it also has the divaricate peduncles and pedicels. My No. 5580 from Provo, Utah, referred by them to this species is too immature to tell what it is, but some of the fruit is constructed below the tip like Leibergi, and with the minute depressed stylopodium. My No. 5893t from Marysvale, Utah, is not referred anywhere by them but is typical obtusa. O. nuda is readily recognized in California by the small leaves, broad leaflets and slender habit with elongated internodes and peduncles, but this form has both beaked and beakless fruit; when the beak is produced it is referred to brevipes by Coulter and Rose. The fruit is short and with short tails, pedicels longer than the fruit, plants mostly pubescent. This is represented in the interior more by the form obtusa, with smooth foliage somewhat larger and more pointed and narrower leaflets. All the species of Osmorhiza have the two forms of leaves, broad and deeply serrate or lobed leaflets, and lanceolate and less lobed and shallow serrate leaflets, which occur indifferently with the varying fruit characters. In the shade the leaflets are larger and more pubescent, in the sun they are much reduced, thicker and nearly smooth. Typical O. divaricata is characterized by the nearly linear beaked fruit with tail from nearly equal to half the body, pedicels nearly as long as the fruit (the central one often 1-2 inches long), large and acuminate leaflets, stylopodium longer than wide, plants nearly smooth.

Sanicula Marilandica L. Common from Evaro and Mission Creek to Sperry Glacier and Gunsight Lake.

Cornus Baileyi Evans. Is reported from our region, but the characters do not hold.

Pyrola minor L. Blackfoot Glacier.

Pyrola secunda L. Frequent from Alta northward.

Pyrola aphylla Smith. Yellow Bay and MacDougal Peak.

Pyrola chlorantha Swz. Yellow Bay and Bigfork.

Pyrola picta Smith. Como Peak.

Pyrola rotundifolia L. Common, Alta to Sperry Glacier.

Pyrola rotundifolia var. **bracteata** (Hook.) Gray. Belton, Gunsight Lake.

Pyrola rotundifolia var. **uliginosa** (Torr.) Gray. From MacDonald Lake in the Mission Mountains northward by Umbach, Miss Norton, MacDougal and Vreeland.

Pyrola rotundifolia var. **incarnata** DC. Mission Creek to St. Mary's Lake in the Sperry Glacier region.

Kalmia glauca var. **microphylla** Hook. MacDougal Peak. Common on all the peaks of the Sperry Glacier region.

Phyllodoce empetriformis (Smith) D. Don. Como Peak, common on all the peaks of the Sperry Glacier region, also Mission Creek. P. intermedia (Hook.) Rydberg.

Phyllodoce glanduliflorus (Hook.) Coville. Como Peak, Mission Creek. Common on all the peaks of the Sperry Glacier region. P. hybrida Rydberg.

Ledum glandulosum Nutt. Como Peak, Mission Creek, Alta, Belton.

Rhododendron albiflorum Hook. McDonald Peak and Mission Creek, Como Peak. This answers almost exactly to Cladothamnus.

Arctostaphylos Uva-ursi (L.) Spreng. Common everywhere on the mountains.

Vaccinium membranaceum Dougl., V. globulare Rydberg. Common at middle elevations from Alta northward.

Vaccinium caespitosum Mx. Upper Marias Pass.

Vaccinium myrtilloides var. **microphyllum** Hook. Common from Alta northward.

Vaccinium Canadense Kalm. Belton, Alta.

Centunculus minimus L. Ronan.

Douglasia montana Gray. Garrison. Missoula (Elrod).

Androsace septentrionalis L. Upper Marias Pass, Sperry to Blackfoot Glacier.

Androsace filiformis Retz. Alta.

Primula Parryi Gray. Como Peak.

Dodecatheon pauciflorum (Durand) Greene. Common from Alta northward.

Dodecatheon Meadia var. **lancifolium** Gray. Alta.

Dodecatheon Meadia var. **alpinum** Gray. Upper Marias Pass.

Frasera speciosa Dougl. Bitter Root Mountains.

Frasera albicaulis Griseb. Alta.

Gentiana Amarella L. Common from Alta northward.

Gentiana glauca Pall. Sperry Glacier. Also by Umbach.

Gentiana affinis Griseb. Polson Swamp, Big Arm.

Apocynum androsaemifolium L. Darby to Upper Marias Pass.

Apocynum cannabinum L. Yellow Bay, Dayton, Polson, Ravalli.

Convolvulus arvensis L. Bigfork, Belton, St. Ignatius Mission.

Phlox Douglasii Hook. Como Peak, Lambert Valley. Missoula (Elrod).

Gilia debilis Wat. McDonold Peak (Elrod).

Gilia aggregata (Pursh) Spreng. Alta, Mission Creek. Missoula (Elrod).

Gilia linearis (Nutt.) Gray. Common from Alta to Lake McDonald.

Gilia gracilis (Dougl.) Hook. Ravalli, Jocko Creek, MacDougal.

Gilia minutiflora Bth. Alta.

Gilia pharnaceoides Bth. Alta to Upper Marias Pass.

Polemonium micranthum Bth. Hot Springs.

Polemonium coeruleum L. Alta.

Polemonium humile R. & S. Alta to Blackfoot Glacier.

Polemonium humile var. **pulchellum** (Bunge) Gray. MacDougal Peak and Mission Creek.

Polemonium confertum Gray. Gunsight Peak.

Phacelia Franklinii Gray. Alta, Evaro.

Phacelia heterophylla Pursh. Alta to Sperry Glacier region.

Nemophila breviflora Gray. Garrison.

Hydrophyllum capitatum Dougl. Bigfork, McDonald Lake in the Mission Mountains.

Lithospermum ruderale Dougl., L. lanceolatum Rydberg. Common, Alta to Upper Marias Pass.

Lithospermum arvense L. Bigfork.

Mertensia oblongifolia G. Don. Mission Creek, Upper Marias Pass. Columbia Falls (Williams), Missoula (MacDougal and Elrod).

Lappula Redowskii (Hornem.) Greene. Common Alta to Bigfork.

Lappula Redowskii var. **cupulata** (Gray Bot. Cal. 1 530 as Echinospermum Red. var.). This grows with the other and grades into it.

Lappula floribunda (Lehm.) Greene. Alta and northward.

Krynitzkia canescens Gray. Upper Marias Pass and Browning.

Krynitzkia Californica Gray. Alta, Evaro, Browning.

Krynitzkia Watsoni Gray. Darby.

Krynitzkia affinis Gray. Evaro, Alta.

Krynitzkia crassi Gray. Garrison.

Krynitzkia crassisepala Gray. Garrison.

Verbena bracteosa Mx. Ravalli to Browning.

Verbena stricta Vent. Hot Springs.

Monarda fistulosa L. Common. Evaro to Belton.

Lycopus uniflorus Mx. Rost Lake, Swan Lake, Schultze's cabin.

Lycopus Virginicus L. Bigfork and Swan Lake.

Lycopus Americanus Muhl. Bigfork, Jordan Lakes, Hot Springs.

Mentha arvensis var. **Canadensis** (L.) Briquet., M. rubella Rydberg. Bigfork, Missoula (Elrod).

Mentha arvensis var. **glabrata** (Bth.) Fernald. Common all around Flathead Lake, Swan Lake, Hot Springs, St. Ignatius Mission.

Stachys palustris L. Common, Evaro and Ravalli to Whitfish and Rexford.

Physostegia parviflora Gray. Common all around Flathead Lake, Missoula (Elrod).

Prunella vulgaris L. Alta and northward.

Agastache urticifolia (Bth.) Rydberg. Evaro. Missoula (Elrod).

Nepeta Cataria L. Bigfork, Mission Creek.

Dracocephalum parviflorum Nutt. Ravalli, Evaro, Alta. Jocko Creek (MacDougal).

Scutellaria galericulata L. Common in swamps at Bigfork, Hot Springs, Swan Lake, Evaro, and around Flathead Lake.

Solanum triflorum Nutt. Evaro.

Physalis pubescens L. Bigfork.

Pedicularis bracteosa var. **Montanensis** (Rydberg Torr. Bull. 24 293 as species). This does not differ in anything but the purple flowers. The low altitude forms have spikes a foot long. Lambert Valley, Mission Creek, McDonald Lake, Bigfork, MacDougal Peak and Lake McDonald to St. Mary's.

Pedicularus Canbyi Gray, was again found on McDonald Peak. Also got on Silloway Peak by MacDougal.

Pedicularis Groenlandica Retz., Elephantella Rydberg. Frequent in the high mountains from Alta northward. All the other species of Pedicularis reported from this region were found.

Orthocarpus luteus Nutt. Upper Marias Pass, Bull and Wild Horse Islands.

Castilleia miniata Dougl. It is very variable in the pubescence and length of galea, very common from Alta northward.

Castilleia angustifolia (Nutt.) G. Don. Bigfork.

Castilleia pallida HBK. This is a very doubtful species. Common from Evaro and Ravalli northward.

Castilleia pallida var. **lutescens** Greenman. Wild Horse Island, Bigfork, Upper Marias Pass, MacDougal Peak (Miss Norton).

Castilleia parviflora. This has been reported from various parts of our region, but all seem to be forms of angustifolia or miniata. I can make nothing out of the species proposed by Rydberg.

Castilleia pallescens (Gray) Greenman. Ravalli, Ronan, Evaro, Missoula (MacDougal).

Veronica Americana Schw. Common from Alta northward.

Veronica alpina L., V. Wormskioldii R. ¢ S. Mission Creek to Blackfoot Glacier.

Veronica serpyllifolia L. Alta to Blackfoot Glacier.

Veronica serphyllifolia L. Alta to Blackfoot Glacier.

Synthyris rubra (Hook.) Bth. Mission Creek, Evaro, Ravalli, Ronan, Missoula (Elrod).

Gratiola Virginiana L. Bigfork, Wild Horse and Bull Islands, Polson (also by Miss Norton). Rost Lake (MacDougal).

Mimulus caespitosus Greene. Lambert Valley, Sperry to Blackfoot Glacier.

Mimulus Breweri (Greene) Rydberg. Alta.

Mimulus Langsdorfii Donn. Common Alta to Bigfork and MacDougal Peak.

Mimulus moschatus Dougl. Alta, Mission Creek, Evaro, Trail Creek (MacDougal).

Scrophularia nodosa var. **Marylandica** (L.) Gray. Ravalli, St. Ignatius Mission.

Pentstemon acuminatus Dougl. Alta, Deer Lodge Valley.

Pentstemon eriantherus Pursh., P. cristatus Nutt. Deer Lodge Valley, Missoula (Elrod).

Pentstemon attenuatus Dougl. Prairies on Wild Horse Island, Ravalli, Garrison, Ronan, Evaro.

Pentstemon procerus Dougl. Missoula, McDonald Lake in the Mission Mountains, Upper Marias Pass.

Pentstemon procerus var. **micrantus** (Nutt. Jour. Phil. Acad. 7 45 as species). Alta, Missoula (Elrod), Columbia Falls (Williams).

Pentstemon ovatus Dougl. Wild Horse Island, MacDougal Peak. Mission Mountains (MacDougal) as P. pinetorum.

Pentstemon Richardsonii Dougl. Alta, Como Peak, Missoula, Evaro.

Pentstemon Menziesii Hook. This is a very variable species and has received many names, but the forms all intergrade. Common on all the peaks from Como Peak northward.

Verbascum Thapsus L. Bigfork, Ravalli, Columbia Falls.

Verbascum Blattaria L. St. Ignitaus plains.

Utricularia vulgaris L. Bigfork. Also found previously by Elrod and Miss Norton.

Orobanche fasciculata Nutt. Bigfork, Wild Horse Island, Browning, Wild Horse Island (Elrod).

Orobanche comosa Hook. Hot Springs.

Plantago major L. Swan Lake, and all the settlements around Flathead Lake.

Plantago Tweedyi Gray. Deer Lodge Valley, Browning.

Plantago Purshii R. & S. Common on the low lands throughout.

Plantago Purshii var. **aristata** (Mx. Fl. 1 95 as species). Ravalli.

Galium Aparine L. Missoula, Ravalli.

Galium Aparine var. **Vaillantii** (DC.) Koch. Reported from McDonald Lake in the Mission Mountains by MacDougal.

Galium trifidum Mx. Common from Alta northward.

Galium asperrimum Gray. Alta, Darby.

Galium triflorum Mx. Common from Alta northward.

Galium boreale L. Common from Alta northward.

Sambucus pubens L. MacDougal Peak, Alta.

Sambucus melanocarpa Gray. Common from Alta northward.

Sambucus glauca Nutt. Bigfork and Yellow Bay.

Sambucus decipiens n. sp. This is what has passed for S. Canadensis throughout the Rocky Mountain region and has been called S. glauca by many because of the remarkably glaucous fruit. It differs from that species in the regular elderberry habit, namely, tufted and short-lived stems and very large leaves, and differs conspicuously from S. Canadensis in always having white-glaucous fruit. Berries 5-6 mm .wide. Joints of stems very prominent. Leaflets oblong-lanceolate, acuminate, smooth. Corymbs with 5-7 stout branches, the whole often 4.5 dm. wide and very heavy. Fruit almost black, pleasant. It grows in open clumps normally about 3.5 m. high, but is stouter than the eastern S. Canadensis, has larger leaves, and larger corymbs and fruit which is always glaucous. The type is from my specimens from St. Ignatius Mission, others are from the Hot Springs. Other all my material distributed from the West except my Californian material as S. glauca. Middle Temperate life zone. Ravalli, Alta, Mission Creek, Ravalli. Not S. Neo-Mexicana Wooton which is apparently S. Mexicana.

Linnaea borealis L. Everywhere in the woods.

Symphoricarpos racemosus Mx. Common in all localities.

Symphoricarpos rotundifolius Gray. S. vaccinioides Rydberg. Alta, Ronan, Ravalli, Evaro.

Lonicera Utahensis Wat. Frequent from Alta northward.

Lonicera involucrata Banks. Common from Alta northward.

Valeriana sylvatica Banks., V. septentrionalis Rydberg, V. occidentalis Heller. From Alta northward. Common.

Valeriana Sitchensis Bong. This is well marked in the extreme forms but seems to vary into the above. From Mission Creek to Blackfoot Glacier.

Echinocystis lobata (Mx.) T. & G. Bigfork and Ravalli. Cult.

Specularia perfoliata (L.) A. DC. Ravalli, Ronan, McDonald Lake, MacDougal.

Campanula rotundifolia L. Everywhere.

Heterocodon rariflorum Nutt. Ronan.

Lobelia Kalmii L. Rost Lake, Polson Swamp. Also by previous collectors.

Tragopogon porrifolius L. Bigfork.

Microseris nutans (Geyer) Sch. Mission Creek, Columbia Falls (Williams).

Hieracium gracile Hook. McDonald and MacDougal Peaks and through the Sperry Glacier region.

Hieracium cynoglossoides Arvet-Touv. Wild Horse Island, Ravalli, Evaro. This is a very doubtful species.

Hieracium Scouleri Hook. H. griseum Rydberg. Rydberg in making his untenable species goes directly in the face of the statement of Gray in the Synoptical Flora page 427 that Scouler distributed specimens of H. cynoglossoides as H. Scouleri, and in the face of Hooker's original description. Common from Alta northward.

Crepis glauca (Nutt.) T. & G. Deer Lodge Valley.

Crepis runcinata (James) T. & G. Bigfork, Ronan.

Crepis acuminata Nutt. Frequent from Alta northward.

Crepis intermedia Gray. A very poor species. Alta to Bigfork.

Crepis occidentalis Nutt. Garrison.

Prenanthes hastata var. **sagittata** (Gray Syn. Fl. 1 2 435 as alata var.). Frequent from Alta northward to Blackfoot Glacier.

Agoseris aurantiaca (Hook.) Greene. From Alta northward.

Agoseris gracilens (Gray) Greene. Published by Greene as gracilenta. Alta, MacDougal and McDonald Peaks. Hardly more than a variety of the above.

Agoseris grandiflora (Nutt.) Greene. Alta to Bigfork.

Taraxacum officinale Weber. Common as a noxious weed from Alta northward. The indigenous alpine variety rare in the Sperry Glacier region.

Lactuca Ludoviciana (Nutt.) DC. Bigfork and Mission Creek .

Lactuca pulchella (Pursh) DC. Common around Flathead Lake, always appearing as if an introduced plant.

Lactuca spicata (Lam.) Hitchk. Bigfork, Mission Creek, St. Ignatius Mission, Polson, Hot Springs.

Sonchus asper (L.) Hill. Bigfork, Hot Springs, Mission Creek.

Sonchus oleraceus L. Dayton.

Cirsium arvense (L.) Scop. Evaro, Deer Lodge Valley.

Cirsium Hookeriana Nutt. Alta and northward.

Cirsium Drummondii T. & G. Blackfoot Glacier.

Cirsium Hallii (Gray Proc. Am. Acad. 19 56 as Cnicus). Dayton, Hot Springs, Yellow Bay, St. Ignatius Mission.

Cirsium undulatum (Nutt.) Spreng. Ravalli to Bigfork, rather common.

Gnaphalium decurrens Ives. Darby, Columbia Falls (Williams), Swan Lake (Umbach).

Gnaphalium palustre Nutt. Frequent from Alta to Browning.

Antennaria luzuloides T. & G. Bigfork (Elrod), Columbia Falls (Williams).

Antennaria pulcherrima (Hook.) Greene. Ravalli.

Antennaria anaphaloides Rydberg. Evaro, McDonald Lake in the Mission Mountains, Upper Marias Pass.

Antennaria racemosa Hook. Alta to Blackfoot Glacier.

Antennaria Howellii Greene. Evaro.

Antennaria parvifolia Nutt. Garrison.

Antennaria rosea (Eaton) Greene. A very doubtful species. Bigfork, Alta, Evaro.

Antennaria Hendersoni Piper. Bigfork, Alta, Evaro, McDonald Peak.

Antennaria microphylla Rydberg. Somers, Missoula and Bigfork (MacDougal).

Antennaria media Greene. MacDougal Peak, Sperry to Blackfoot Glacier.

Antennaria umbrinella Rydberg. There is a striking difference in the bracts between this and the above but they do not seem to be distinct, in addition the clavellate pappus does not seem to hold. Darby to Blackfoot Glacier.

Antennaria flavescens Rydberg. Missoula (Elrod). This material named by Rydberg differs materially from his description and is not at all flavescent and seems to be A. parvifolia. Alta, Evaro.

Adenocaulon bicolor Hook. Everywhere in the mountains to Gunsight Lake from Ravalli northward.

Artemisia dracunculoides Pursh. Kalispell, Dayton, Wild Horse Island, Elrod Peak (Elrod).

Artemisia frigida Willd. Hot Springs to Browning.

Artemisia biennis Willd. Whitefish, Browning.

Artemisia Ludoviciana Nutt. Common from Alta northward.

Artemisia Ludoviciana var. **atomifera** (Piper Fl. Wash. 588 as species). McDonald Peak.

Artemisia discolor Dougl. Blackfoot Glacier, Upper Marias Pass.

Artemisia discolor var. **incompta** (Nutt.) Gray. Gunsight Pass.

Artemisia tridentata Nutt. Alta, Little Bitter Root.

Artemisia rigida (Nutt.) Gray. Wild Horse Island, also by Elrod.

Artemisia absinthium L. Bigfork.

Matricaria discoidea DC. Common Alta and northward.

Chrysanthemum leucanthemum L. Ravalli as a bad weed.

Achillea Millefolium L. Alta and northward. The var. rosea also occurs.

Anthemis arvensis L. St. Ignatius Mission.

Senecio vulgaris L. Bigfork, Columbia Falls, Belton.

Senecio negacephalus Nutt. From McDonald Peak to Gunsight Pass.

Senecio integerrimus Nutt. Deer Lodge Valley, Missoula, Upper Marias Pass. Also MacDougal Peak MacDougal.

Senecio hydrophilus Nutt., S. hydrophiloides Rydberg. Evaro.

Senecio triangularis Hook., S. saliens Rydberg. Alta to Blackfoot Glacier. S. variifolius Rydberg is a more robust form.

Senecio hydrophilus Nutt., S. hydrophiloides Rydberg. Evaro.

Senecio lugens Rich. Alta.

Senecio Fremonti T. & G. MacDougal Peak to Blackfoot Glacier.

Senecio canus Hook. Missoula to Gunsight Pass.

Senecio subnudus DC. Mission Creek, Sperry to Blackfoot Glacier.

Senecio ovinus Greene. Sperry Glacier. Probably only a form of the above.

Senecio Balsamitae Muhl. Monida.

Senecio cymbalarioides Nutt. Lima and Monida, Stanton Lake (Williams), MacDougal and Silloway Peak (MacDougal).

Arnica Parryi Gray. MacDougal and McDonald Peaks.

Arnica longifolia Eaton. Alta to Blackfoot Glacier.

Arnica amplexicaulis Nutt. Whitefish. Mrs. Kennedy's specimen quoted by Rydberg as this species is A. foliosa.

Arnica foliosa Nutt. Bigfork and Swan Lake, Lambert Valley.

Arnica pedunculata Rydberg., A. monocephala Rydberg. Evaro.

Arnica betonicaefolia Greene. McDonald Peak, Lambert Valley, Blackfoot Glacier.

Arnica betanicaefolia var. **gracilis** (Rydberg Torr. Bull. 24 297 as species). A. multiflora Greene. McDonald Peak and Lake. Throughout the Sperry Glacier region.

Brichellia grandiflora Nutt. McDonald Peak and Lake, Lincoln Pass at Sperry Glacier.

Liatris punctata Hook. Browning.

Gutierrezia Sarothrae (Pursh) Britton. Deer Lodge Valley.

Grindelia nana Nutt. Ravalli, Flathead plains to Hot Springs.

Chrysopsis villosa (Pursh) Nutt. Ravalli and Garrison to Bigfork.

Bigelowia viscidiflora (Hook.) DC. Wild Horse Island, Polson.

Bigelowia nauseosa (Pall.) Jones. Alta to Browning, not common.

Solidago humilis Pursh. Browning. Elrod Peak (Elrod), Silloway Peak, (MacDougal).

Solidago confertiflora. Somers.

Solidago Tolmieana Gray. Elrod Peak ,Elrod), Bigfork(MacDougal).

Solidago Guiradonis Gray. Bull Island.

Solidago Missouriensis Nutt. Alta to Browning.

Solidago serotina Ait. Swan Lake (also Miss Norton and Umbach), Ravalli.

Solidago elongata Nutt. Bigfork, Rost Lake (MacDougal).

Solidago Canadensis L., S. caurina Piper. Alta to Browning.

Solidago Canadensis var. **salebrosa** (Piper Fl. Palouse 185 as species). This is a marked form intergrading with the type and differs in the heads being twice the size of those of the species. Without the intergrades it would be placed with S. serotina. Wild Horse Island, Mission Creek.

Solidago nemoralis Ait. Deer Lodge Valley.

Solidago occidentalis (Nutt.) T. & G. Bull Island, Echo Lake, Ravalli, Missoula (Elrod).

Hoorebekia acaulis (Nutt. Jour. Phil. Acad. 7, 33 as Chrysopsis). Ours is the var, caespitosa (Nutt. same cit. as Chrysopsis). Bigfork (Miss Norton.

Hoorebekia lanceolata (Hook. Fl. Bor. Am. 2 25 as Donia). Not yet reported.

Hoorebekia uniflora (Hook. l. c. as Donia). Browning.

Hoorebekia integrifolia (Porter Proc. Am. Acad. 16 79 as Aplopappus). Deer Lodge Valley, Upper Marias Pass.

Aster scopulorum Gray. Deer Lodge Valley.

Aster stenomeres Gray. Deer Lodge Valley and Big Hole country.

Aster Hallii Gray. Dayton.

Aster Fremonti (T. & G.) Gray. Swan Lake, St. Ignatius Mission.

Aster occidentalis Nutt. Bigfork and around Flathead Lake.

Aster foliaceus Lindl. Alta to Blackfoot Glacier.

Aster foliaceus var. Eatoni Gray. Bigfork, Wild Horse Island.

Aster Cusickii Gray. McDonald Peak.

Aster laevis L. Alta to Belton. The var. Geyeri at Alta.

Aster oblongifolius var. **rigidus** Gray. Upper Marias Pass.

Aster modestus Lindl. St. Ignatius Mission, Alta.

Aster radulinus Gray. Elrod Peak (Elrod).

Aster Sibiricus L. Blackfoot Glacier, Upper Marias Pass. Elrod Peak (Elrod).

Aster canescens Pursh. Deer Lodge Valley.

Erigeron armeriaefolius Turcz. Ledebour describes the two forms that Rydberg tries to separate. Alta.

Erigeron acris L. Bigfork.

Erigeron acris var. **draebachensis** (Mueller) Blytt. Lambert Valley and McDonald Lake.

Erigeron acris var. **debilis** Gray. Alta.

Erigeron alpinus L. Blackfoot Glacier. This is a well marked species.

Erigeron ramosus (Walt.) BSP. Bigfork, Ravalli, Garrison.

Erigeron divergens T. & G. Bigfork, Wild Horse Island, Ronan, Ravalli, Missoula.

Erigeron corymbosus Nutt. Bigfork, Wild Horse Island, Lima.

Erigeron glabellus Nutt. This is E. oblanceolatus Rydberg which may be distinct. Ravalli, Alta, Lambert Valley.

Erigeron speciosus DC. Alta and northward. Common.

Erigeron macranthus Nutt. Mission Creek, Blackfoot to Sperry Glacier. These two species are too close together.

Erigeron uniflorus L. Gunsight Pass, Elrod Peak (Elrod).

Erigeron grandiflorus Hook. Sperry to Blackfoot Glacier.

Erigeron concinnus (H. & A.) T. & G. Ravalli, Missoula, Wild Horse Island. Also by former collectors.

Erigeron filifolius Nutt. Columbia Falls (Williams), Polson (Umbach).

Townsendia Parryi Gray. Garrison.

Iva axillaris Pursh. Ronan to Browning.

Iva xanthiifolia Nutt. Belton, Hot Springs, St. Ignatius Mission. It acts like an introduced plant.

Xanthium Canadense Mill. Hot Springs, St. Ignatius Mission, Browning.

Rudbeckia occidentalis Nutt. Ravalli, Evaro.

Lepachys columnaris Sims. Ft. Missoula. Evidently introduced but well established.

Balsamorhiza Hookeri Nutt. Deer Lodge Valley.

Helianthus annuus L. Common.

Helianthus rigidus Desf. Dayton, Columbia Falls, Belton.

Helianthus Nuttallii T. & G. Dayton, Ravalli, Kalispell, Hot Springs.

Helianthus Californicus var. Utahensis Eaton. St. Ignatius Mission.

Coreopsis Atkinsoniana Lindl. Sand Point, Idaho, Whitefish.

Bidens cernua L. Ronan, Whitefish, Swan Lake, St. Ignatius Mission.

Madia exigua (Smith) Greene. Bigfork.

Madia glomerata Hook. Bigfork, St. Ignatius Mission, Hot Springs, Columbia Falls, Darby, Upper Marias Pass, Browning.

MOSSES.

Considerable attention has been given the moss flora, though the knowledge of the flora is not by any means complete.

In 1898 Professor John M. Holzinger devoted a season to the mosses of the Sperry Glacier region. In 1901 W. P. Harris devoted a season to the mosses of the vicinity of Flathead Lake. This material was identified by Carolyn M. Harris. In 1908 I also collected the more common mosses of the Lake and adjacent mountains, though no attempt was made to make it thorough, as my time was devoted to the higher plants chiefly.

All my material was identified by Mr. Holzinger, and the Harris material was examined by Mrs. Britton.

Fortunately Mr. Holzinger had prepared a manuscript of his Sperry Glacier mosses which I have prevailed on him to permit me to print in this report. It is so much more complete than the Harris or my list that it is given as prepared. I have added to it the localities and few additional species found on the Harris list and my own, always adding the name of Harris or Jones to all species collected by us, so that all other localities and notes may be known as those of Mr. Holzinger.

"In July, 1898, the writer, J. M. Holzinger, in company with Mr. James Blake, made a vacation trip into Northwest Montana, during which they collected the Mosses and Hepatics herewith published. The region visited is reached by the Great Northern railway, which we left at Belton, thirty miles east of Kalispell, striking some twenty miles north, to the north end of Lake McDonald. There we pitched our permanent camp. The country is very rugged and secluded. It is especially interesting because of the several glaciers which nestle among the precipitous mountain peaks. We visited only one of these, Sperry Glacier.

During our brief stay we made the following excursions: To Holzinger's Basin, eight miles east of camp, July 16 to 19; to McCrimmin Falls, on the McDonald Creek, near the upper end of the lake, July 20; to Mt. Trilby, four miles northwest of camp, July 21; to Sperry Glacier, twelve miles northeast of camp by way of Holzinger's Basin and the Rim, July 24 to 26; and to Avalanche Basin, below Sperry Glacier, 10 miles northeast of camp. A more detailed account of this interesting region may be found in the September number, 1900, of the Bulletin of the American Bureau of Geography.

The determination of the collection has been delayed for various reasons. Dr. R. H. True has determined most of the Dicrana; Dr. H. J. Grout, the Eurhynchia and Brachythecia, and several other species; Dr. G. N. Best, the Prendoleskear, etc.; Dr. C. Warnstork the Sphagna; Mr. Renauld, the Harpidia; Mrs. Britton has determined the Orthotrica, and has critically examined a considerable number of species submitted, especially Grimmias and Mniums. Messrs. Cardot and Theriot have generously examined and determined a promiscuous lot of things. Dr. A. W. Evans has determined all the Hepaticae. To all these persons I herewith express my gratitude for their generous and ever cordial assistance. Since I have been able to do comparatively little toward determining this collection, the credit for the work is due the more largely to my biological friends.

"The numbers in this report refer to a set of mosses from this collection which were distributed in 1899."

From manuscript by Professor J. M. Holzinger.

In the Botanical Gazette of Aug., 1900, were published 13 species and varieties of mosses from this collection, being either new or new to North America. They are again inserted in the general list herewith submitted.

Sphagnum acutifolium var. **viride** W., form pusillum. W. Base of Sperry Glacier.

Sphagnum acutifolium var. **versicolor** form pusillum W. Base of Sperry Glacier.

Sphagnum molle Sull. Base of Sperry Glacier.

Sphagnum molle, form **squarrosulum** Gravet. Base of Sperry Glacier.

Sphagnum robustum Roell. Forms **Fibrosum** and **pallido-flavescens** Roell. (Identified by Dr. Julius Roell). "Interesting by reason of the numerous fibers, and the single pores in the branch leaves, by its pale cortex and low stature, all high altitude characters." This grew in the cold water at the camping place below the rim, Sperry Glacier, alpine.

Andreaea petrophila Ehrh. Banks of McDonald Creek near McCrimmin Falls, Sperry Glacier region.

Andreaea alpestris Sch. Mt. Trilby and Mt. Stanton.

Dicranoweisia cirrhata Lindb. Mt. Trilby and Mt. Stanton.

Dicranoweisia contermina Ren. & Card. Holzinger Basin, Mt. Trilby.

Dicranoweisia subcompacta Card. & Ther. in Bot. Gaz. 29 122 (1900). Along the trail from Holzinger Basin to the Rim, which is the highest ledge of rock in the ascent from Holzinger Basin to Sperry Glacier.

Dicranoweisia cirrhata Lindb. Sperry Glacier and Darby (Jones).

Cynodontium polycarpum B. S. Holzinger Basin.

Cynodontium polycarpum var. **strumiferum** B. S. McCrimmin Falls, head of Lake McDonald, Sperry Glacier region. Also by Jones at Swan Lake.

Cynodontium virens B. S. Sperry Glacier (Jones).

Dicranum undulatum Ehrh. Belton (Jones).

Dichodontium pellucidum Sch. a form. Holzinger Basin.

Dicranum Bonjeani De Not. Avalanche Basin. Also by Harris at McDonald Lake in the Mission Mountains, and by Jones at foot of MacDougal Peak, Bigfork and Yellow Bay. Alta and McDonald Lake in the Mission Mountains.

Dicranum fragilifolium Lindb. Holzinger Basin, Mt. Trilby. Also by Harris at Mud Creek and McDonald Lake in the Mission Mountains, and by Jones at Bigfork and Somers.

Dicranum falcatum Hedw. Avalanche Basin, Sperry Glacier, Holzinger Basin.

Dicranum fuscescens Turn. Mt. Stanton and Mt. Trilby. Also at Bigfork (Jones).

Dicranum fuscescens var. **Eatoni** Ren. & Card. Base of Sperry Glacier.

Dicranum fuscescens Turn. a form approaching D. trachyphyllum Ren. & Card. Mts. Stanton and Trilby.

Dicranum Howellii Ren. & Card. Mt. Trilby.

Dicranum longifolium Hedw. Avalanche Trail. McCrimmin Falls.

Dicranum neglectum Juratz. McCrimmin Falls at the north end of Lake McDonald, and along the trail to the river.

Dicranum scopariiforme Kindb. Mt. Trilby, Avalanche Basin.

Dicranum scoparium Hedw. Avalanche Basin.

Dicranum Starkei Web. & Mohr. Holzinger Basin and from there to the Rim and Sperry Glacier.

Dicranum strictum Schleich. O'Keefe canon, Harris. Also Bigfork and Somers, Jones. Lake McDonald and Swan Lake (Jones).

Dicranella squarrosa (Schrad.) W. P. Sch (Fide Dr. Best). Blackfoot Glacier (Jones).

Fissidens bryoides var. **gynandrus** (Buse) R. Ruthe.Shores of Lake McDonald and Avalanche trail, Sperry Glacier region.

Ceratodon purpureus (L.) Brid. Common everywhere in Sperry Glacier region. Mud Creek, Harris; Bigfork and Belton (Jones).

Distichium capillaceum B. S. Mts. Stanton and Trilby. McDonald Peak in the Mission Mountains, Big fork and Sperry Glacier (Jones). Subalpine (Jones).

Barbula ruralis Hedw. a form. Mts. Stanton and Trilby. O'Keefe canon and McDonald Lake in the Mission Mountains (Harris).

Barbula Mulleri (Br.) B. S. Wild Horse, Bigfork, Alta and Somers (Jones).

Schistidium alpicola (Sw.) Limpr. Mts. Stanton and Trilby.

Barbula aciphylla B. S. Base of Sperry Glacier.

Barbula rufipila Card. & Ther. Bot. Gaz. 29 123 (1900). Avalanche Basin and Holzinger Basin.

Barbula ruralis Hedw. (?) Sperry Glacier (Jones).

Scouleria aquatica Hook. In the Creek through Holzinger Basin, Avalanche Creek.

Schistidium alpicola (Sw.) Limpr. Mts. Stanton and Trilby.

Schistidium confertum (Funck) B. S. Base of Sperry Glacier.

Schistidium gracile (Schleich.) Limpr. Holzinger Basin and Mts. Stanton and Trilby.

Schistidium alpicola var. **rivulare** (Brid.) Wahl. Avalanche Basin, near the Rim at the base of Sperry Glacier.

Grimmia alpestris Schleich. Holzinger Basin, Avalanche Basin, Sperry Glacier.

Grimmia commutata Hub. Mts. Stanton and Trilby.

Grimmia Doniana Sm. Mts. Stanton and Trilby.

Grimmia Holzingeri Card. & Ther. Bot. Gaz. 29 123 (1900). Base of Sperry Glacier and Mt. Trilby.

Grimmia mollis B. S. Base of Sperry Glacier.

Grimmia subsulcata Limpr. in Rabenh. Crypt.. Fl. Laubm, 757. Mt. Trilby.

Grimmia montana B. S. Bigfork, Harris; Wild Horse Island (Jones).

Grimmia calyptrata Hook. Missoula (Harris).

Grimmia tenerrima Ren. & Card. Mt. Trilby, Sperry Glacier, Avalanche Basin.

Grimmia torquata Grev. Mts. Stanton and Trilby.

Grimmia sphaerica Sch. Sperry Glacier (Jones.)

Rhacomitrium canescens Brid. Mts. Stanton and Trilby. Bigfork (Harris).

Rhacomitrium canescens var. **ericoides** Brid. Holzinger Basin.

Rhacomitrium heterostichum Brid. Holzinger Basin.

Rhacomitrium aciculare Brid. Sperry Glacier.

Rhacomitrium patens Hub. Holzinger Basin.

Rhacomitrium Sudeticum B. S. Holzinger Basin. Sperry Glacier, McDonald Peak at 5500° alt. (Jones).

Encalypta contorta (Wulf.) Lindb. McDonald Peak at 5500° alt. (Jones).

Encalypta Macounii Aust. McDonald Lake in the Mission Mountains (Harris).

Encalypta rhabdocarpa Schwaegr. Bigfork (Jones).

Hedwigia ciliata (Dicks) Ehrh. Mts. Stanton and Trilby. Bigfork (Jones).

Orthotrichum obtusifolium Schrad. On Cottonwoods along Avalanche Trail.

Orthotrichum Schlotthauxeri Vent. Mts. Stanton and Trilby.

Orthotrichum speciosum Nees. Shores of Lake McDonald, Sperry Glacier region. Lake McDonald in the Mission Mountains (Harris). Alta (Jones).

Orthotrichum Kingeanum Lesq. Wild Horse Island (Jones).

Orthotrichum rupestre Schleich. McDonald Lake in the Mission Mountains (Harris).

Orthotrichum affine Schrad. Sperry Glacier (Jones).

Orthotrichum speciosum Nees. (Fide Dr. Best). Sperry Glacier and Swan Lake (Jones).

Orthothecium chryseum Sch. Sperry Glacier (Jones).

Amphidium Californicum L. & J. Mt. Stanton.

Amphidium Papponicum Sch. Base of Sperry Glacier, Mt. Trilby.

Amphidium Mougeottii Sch. On trail from Holzinger Basin to the Rim.

Tetraphis pellucida Hedw. Avalanche Basin and Trail. Bigfork, Yellow Bay and Somers (Jones).

Splachnum luteum L. Bigfork (Jones).

Schistotega osmundacea Web. & Mohr. Trail to Holzinger Basin.

Tayloria serrata B. S. Avalanche Basin.

Funaria hygrometrica (L.)Hedw. Shores of Lake McDonald near McCrimmin Falls. Bigfork and Sperry Glacier (Jones).

Bartramia ithyphylla Brid. Mt. Trilby.

Bartramia Oederi (Gunn.) Schwaegr. Bigfork and McDonald Peak (Jones).

Bartramia pomiformis Hedw. Holzinger Basin. Bigfork (Jones).

Conostomum boreale Sm. Base of Sperry Glacier.

Philonotis fontana var. pumila (Turn.) Dix. Mt. Trilby, Avalanche Basin.

Philonotis fontana Brid. a form heterophylla. On the way to the Rim. A plant from Mt. Edwards near the Rim Mr. Dixon determined as an alpine form of P. fontana approaching P. adpressa Ferguss.

Philonotis fontana var. **alpine** Brd. Blackfoot Glacier (Jones).

Philonotis seriata Mitt. Sperry Glacier.

Philonotis glabriuscula Kindb. Sperry Glacier (Jones).

Webera albicans Sch. a form. Base of Sperry Glacier. Blackfoot Glacier (Jones).

Webera carinata (Brid.) (W. cucullata var. carinata Hurnot). New to North America. Base of Sperry Glacier.

Webera commutata Sch. This approaches close to Bryum filum Sch. which is only a form of W. commutata according to Carnot. Base of Sperry Glacier.

Webera crudis (L.) Sch. Avalanche Basin where it is quite abundant. Bigfork, Blackfoot Glacier and Lamber Valley (Jones).

Webera nutans Hedw. Holzinger Basin and Trail, Mt. Trilby, Avalanche Trail. Also O'Keefe canon (Harris) and Sinyaleamin Lake, Sperry Glacier (Jones).

Leptobryum pyriforme Sch. O'Keefe canon (Harris). Sperry Glacier (Jones).

Bryum alpinum var. **denticulatum** Card. & Ther. Bot. Gaz. 29 123 (1900). On the way from Holzinger Basin to the Rim.

Bryum pallescens Schleich. Mts. Stanton and Trilby.

Bryum pallens Sw. (B. distantifolium R. & C.). (Fide Dr. Best). Swan Lake and Sperry Glacier (Jones).

Bryum lucidum Britton. Shores of Lake McDonald, Sperry Glacier region, near the lower end.

Bryum Duvalli Voit. On the trail to the Rim on Mt. Edwards.

Bryum barbatum Wils. The same (?) as B. Stertoni Sch. Plants very close to this species but not fully agreeing with it. Base of Sperry Glacier.

Bryum Atwateriae C. Mull. The plants distributed as this species do not fully agree with it and may prove distinct. Mts. Stanton and Trilby.

Bryum caespiticium L. Bigfork (Jones).

Bryum cirrhatum H. & H. Sperry Glacier (Jones).

Bryum purpurascens B. S. Sperry Glacier (Jones).

Bryum Duvalii var. **latodecurrens** C. M. et Kindb. Swan Like (Jones).

Bryum three species too old for determination. Bigfork and Swan Lake (Jones).

Meesia Albertini B. S. (Fide Dr. Best). Blackfoot Glacier (Jones).

Mnium nudum Williams. Avalanche Basin.

Mnium punctatum var. **elatum** B. S. Avalanche Basin. McDonald Lake in the Mission Mountains (Harris).

Mnium spinulosum B. S. Avalanche Basin, McDonald Lake in the Mission Mountains (Harris), Bigfork, MacDougal Peak, Lake McDonald and Swan Lake (Jones).

Mnium venustum Mitt. Mts. Trilby and Stanton. The plants appear to be dioecious. McDonald Lake in the Mission Mountains (Harris).

Mnium insigne Mitt. McDonald Lake in the Mission Mountains (Harris).

Mnium orthorhynchum B. S. McDonald Lake in the Mission Mountains (Harris), Lake McDonald (Jones).

Mnium affina Bland. McDonald Lake in the Mission Mountains (Harris), Somers (Jones).

Mnium Blyttii B. S. Sperry Glacier (Jones).

Aulacomnium palustre Schew. Holzinger Basin.

Aulacomnium androgynum Schw. Holzinger Basin, Mt. Trilby. McDonald Lake in the Mission Mountains (Harris), Bigfork, Alta and Browning (Jones).

Timmia austriaca Hedw. Holzinger Basin.

Timmia austriaca var. **brevifolia** Ren. & Card. Trail to Holzinger Basin.

Timmia megapolitana Hedw. Mud Creek and McDonald Lake in the Mission Mountains (Harris).

Catharinaea Selwyni (Aust.) Kindb. Avalanche Trail, O'Keefe canon (Harris), Bigfork (Jones).

Tortula ruralis Ehrh. O'Keefe canon and McDonald Lake in the Mission Mountains (Harris).

Pogonatum alpinum Roehl. Avalanche Basin below Little Matterhorn.

Pogonatum alpinum var. **arcticum** Brd. Blackfoot and Sperry Glaciers and McDonald Lake, Mission Mts. (Jones).

Pogonatum alpinum var. **simplex** Sch. Sperry Glacier (Jones).

Pogonatum alpinum Roehl. (?) Forms with nearly entire leaves. Sperry Glacier (Jones).

Polytrichum juniperinum (Hedw.) Willd. Avalanche Basin, (Also Umbach), Bigfork, Alta, Belton, Blackfoot Glacier, Lake McDonald, McDonald Lake in the Mission Mountains (Jones).

Polytrichum angustidens Lindb. fil. (See Bryologist for March, 1905, Vol. 8, p. 30. Note). Leaf section and calyptra are distinctive for this species. The author did not refer to the calyptra, the type specimens, collected by Dr. Sandberg in Idaho in 1891, being old. These specimens of Jones show the calyptra very short, covering hardly more than the operculum an important additional character.—J. M. H. MacDougal Peak, alpine (Jones).

Polytrichum piliferum Schreb. Base of Sperry Glacier, Mt. Trilby, Holzinger Basin. O'Keefe canyon (Harris).

Polytrichum sexangulare Floerke. Base of Sperry Glacier. Blackfoot Glacier (Jones).

Polytarichum strictum Menz. Base of Sperry Glacier. (Also Umbach). Sperry Glacier and McDonald Lake in the Mission Mountains (Jones).

Polytrichum formosum Hedw. Alta (Jones).

Neckera Menziesii Hook. Mts. Stanton and Trilby and McCrimmin Falls. Bigfork (Jones).

Neckera Douglasii Hook. McDonald Lake in the Mission Mountains (Harris).

Climacium Americanum Bird. Bigfork and Lake McDonald (Jones).

Climacium dendroideum (L.) Web. & Mohr. McDonald Lake in the Mission Mountains (Harris), Bigfork, Swan Lake and Mission Creek (Jones).

Fontinalis antiphyretica L. alpine form. Avalanche Trail, Mud Creek (Harris), Hot Springs (Jones).

Dichelyma uncinatum Mitt. Trail to Mt. Stanton.

Pterigynandrum filiforme Hedw. Mts. Stanton and Trilby, Avalanche Trail. Bigfork and McDonald Lake in the Mission Mountains (Jones).

Homalothecium Nevadense Ren. & Cardot. Mts. Stanton and Trilby.

Homalothecium Nevadense var. **subulatum** Ren. & Cardot. Mt. Trilby.

Pseudoleskea radicosa (Mitt.) Lesq. & James. Trail to Holzinger Basin.

Pseudoleskea rigescens Lindb. Holzinger Basin, Mt. Trilby.

Pseudoleskea denudata var. **Holzingeri** Best, in Torr. Bull. 27 229 (1900). Avalanche Basin, Holzinger Basin, Mt. Trilby.

Pseudoleskea atricha Kindb. (Fide Dr. Best). Blackfoot Glacier, Sperry Glacier (Jones).

Pseudoleskea congesta (Wils.) Bry. Eur. (Fide Dr. Best). Blackfoot Glacier (Jones).

Pseudoleskea atrovirens Sch. Blackfoot Glacier (Jones).

Heterocladium procurrens L. & J. Mt. Stanton and Mt. Trilby.

Claopodium Bolanderi Best. Mts. Stanton and Trilby.

Camplothecium lutescens (Huds.) B. S. Bigfork and Wild Horse Island and Alta (Jones).

Camplothecium aeneum (Mitt.) Jacq. Old Stage Station on east side of Flathead Lake on Pinus ponderosa (Harris).

Campylothecium Nuttallii Sch. Alta.

Brachythecium collinum B. S. Mts. Stanton and Trilby.

Brachythecium Leibergii Grout. Holzinger Basin.

Brachythecium rivulare Sch. Avalanche Basin.

Brachythecium salebrosum Sch. Avalanche Basin.

Brachythecium Starkei Sch. Holzinger Basin.

Brachythecium rutabulum var. **flavescens** (Brid.) B. S. Bigfork (Jones), Det. by Dr. J. Grout.

Eurhynchium strigosum B. S. McDonald Lake in the Mission Mountains (Harris). Lkae McDonald (Jones).

Eurhynchium strigosum var. **fallax** Ren. & Cardot. Common on trail to Holzinger Basin.

Thamnium Neckeroides Sch. Trail to Holzinger Basin.

Plagiothecium denticulatum Sch. Holzinger Basin, Mt. Trilby.

Plagiothecium denticulatum var. **microcarpum** Ren. & Card. Avalanche Basin and Trail.

Plagiothecium filiferum Sch. Holzinger Basin, Mt. Trilby, Avalanche Trail.

Plagiothecium olegans Sch. McDonald Lake in the Mission Mountains (Harris).

Plagiothecium sylvaticum Sch., ? Holzinger Basin, Avalanche Trail.

Plagiothecium Sullivantii Sch. Lake McDonald (Jones).

Plagiothecium Millerianum Sch. Lake McDonald (Jones).

Plagiothecium Millerianum Hook. f. (Fide Dr. Best). Lake McDonald (Jones).

Amblystegium varium (Hedw.) Lindb. Mud Creek (Harris), Bigfork (Jones).

Amblystegium varium var. **orthocladon** (L. & J.) form alpinum. Base of Sperry Glacier. (This has been published as new, A. Montanum Bryhn Bryologist, March, 1902, p. 26).

Amblystegium serpens (Hedw.) B S. Bigfork (Jones).

Hypnum aduncum Hedw. Bigfork and Sperry Glacier (Jones.)

Hypnum aduncum group **Kneiffii.** Base of Sperry Glacier.

Hypnum Bestii Ren. & Bryhn in Bryologist Jan. 1901 p. 112, also April 1901 p. 21, 22. In water, along Avalanche Trail.

Hypnum Cardoti Ther. in Bot. Gaz. Aug. 1900 Vol. 29 p. 124. Avalanche Basin.

Hypnum fluitans L. Daphnia Lake (Harris, also Jones), Sperry Glacier (Jones).

Hypnum fluitans var. **brachydictyon** Ren. in Hurnot Mus. Gall. form Holzingeri Ren. in Bot. Gaz. Aug. 1900 Vol. 29 p. 124. Base of Sperry Glacier.

Hypnum callichroum Brid. Yellow Bay (Jones).

Hypnum giganteum Sch. Mud Creek (Harris), Polson Swamp (Jones).

Hypnum molle Dicks. In water along trail to Holzinger Basin, base of Sperry Glacier.

Hypnum molle var. **Schimperianum** Lortz. In water near the top of Mt. Trilby.

Hypnum ochraceum Turn. Holzinger Basin.

Hypnum ochraseum form tenue. On the way to the Rim at the base of Sperry Glacier.

Hypnum ochraceum var. **uncinatum** Milde. A European moss new to North America. Holzinger Basin.

Hypnum subimponens Lesq. Bigfork (Jones).

Hypnum hamulosum B. S. Bigfork (Jones).

Hypnum polygamum Wils. Bigfork and Somers (Jones).

Hypnum reptile Mx. Bigfork (Jones).

Hypnum uncinatum Hedw. Holzinger Basin and Trail, Mt. Trilby, McDonald Lake in the Mission Mountains (Harris), Somers (Jones).

Hypnum uncinatum form **plumosum.** Mt. Trilby.

Hypnum uncinatum var. **subjulaceum** Sch. form Holzingeri Ren. in Bot. Gaz. 29 p. 125 (1900). Base of Sperry Glacier.

Hypnum uncinatum var. **plumulosum** B. S. Bigfork (Jones).

Hypnum cuspidatum L. Mud Creek (Harris).

Hypnum Schreberi Willd. Holzinger Basin. Somers, Yellow Bay and Bigfork (Jones).

Hypnum stellatum var. **protensum** Sch. Avalanche Basin.

Hypnum symmetricum Ren. & Card. McCrimmin Falls at upper end of McDonald Lake, Sperry Glacier region.

Hypnum crista-castrensis L. Bigfork and Lake McDonald (Jones).

Hypnum circinale Hook. McDonald Lake Mission Mts. (Jones).

Hypnum filicinum. Blackfoot Glacier (Jones).

Hypnum pratense Koch. Sperry Glacier (Jones).

Hylacomium proliferum (L.) Lindb. Avalanche Trail, McDonald Lake in the Mission Mountains (Harris), Yellow Bay (Jones).

Hylacomium robustum Kindb. Shores of Lake McDonald, Sperry Glacier region, Bigfork and McDonald Lake in the Mission Mountains (Jones).

Hylacomium splendens Sch. Avalanche Trail. Lake McDonald (Jones).

Hylacomium squarrosum Sch. Avalanche Basin.

Hylacomium triquetrum Sch. Avalanche Basin, Yellow Bay and Bigfork, Belton and Lake McDonald (Jones).

Limnobium bestii Ren. & Bryhn. Blackfoot Glacier (Jones).

"**Dicranoweisia subcompacta** Card. et. Ther., sp. nova.—Dense pulvinato-caespitosa. Caulis simplex vel parcissime ramosus, 6-8 mm. altus dense foliosus. Folia madida suberecta, sicca crispatula, 1-1.5 mm longa, oblongo lanceolata, acuminata, subacuta vel obtusiuscula, superne, canaliculata, nervo basi attenuato usque ad apicem producto vel paululum infra evanido, marginibus inferne planis, superne inflexis, integerrimis, cellulis, irregulariter quadratis vel subrectangularibus, inferioribus laxioribus, juxta costam linearibus, alaribus distinctis, subinflatis, fuscis. Caetera ignota.

"Very nearly allied to the European **D. compacta** Sch., from which it differs by the leaves being more narrowly acuminate and generally subacute, the cells of the areolation larger and with thinner walls, and chiefly by the costa narrower, attenuate below (16 to 25 u broad; it is 55 u in **D. compacta**). Along the trail from Holzinger's Basin to the Rim.

"**Barbula rufipila** Card. et Ther., sp. nova.— **B. aciphyllae** habitu et. foliorum forma omnino similis, differt tantum cellulis duplo majoribus et piloque saepius minus denticulata interdum integro. Specimina sterilia. magis distinctis (superioribus 20-30 u in **B. rufipila**, 12-15 u in **B. aciphylla**) Avalanche Basin, Holzinger's Basin.

"**Fissidens bryoides gymnandrus** (Buse) R. Ruthe. New to North America. Cardot det. Shores of Lake McDonald, Avalanche Trail.

"**Grimmia Holzingeri** Card. et Ther., sp, nova. Minima, tenella, pulvinatula, obscure viridis, inferne fusca. Caulis erectus, 4-6 mm. altus, parce ramosus. ramis interdum attenuatis, subflagellaceis. Folia conferta, minima, 0.50-0.70 mm. longa, 0.20-0.35 lata, madida erecta, sicca appressa, breviter ovato-oblonga, concava, omnia mutica obtuse acuminata, marginibus planis integris, costa canaliculata, usque ad apicem producta, basi 28 u lata, cellulis superioribus bistratosis, quadrato-subrotundatis; inferioribus unisthatosis majoribus, lutescentibus, infimis oblongis vel sublinearibus, omnibus incrassatis. Caetera ignota. This very minute species, resembling in habit the small form of **Andreaea jetrophila**, is quite distinct from all the European and North American species of Grimmia with muticous leaves by the small size, and the shape and areolation of the leaves. Base of Sperry Glacier, Mt. Trilby.

"**Grimmia Mollis** B. S. This European alpine moss is reported from Greenland, and should be found at intermediate stations in Canada. Base of Sperry Glacier. No. 17.

"**Grimmia subsulcata** Limpr. in Rabenh. Crytog. Fl., Laubm, 747. New to North America. Cardot det. Mt. Trilby.

"**Webera carinata** (Brid.) (**W. cucllata carinata** Husnot; **Bryum naviculare** Cardot). New to North America. Cardot det. Base of Sperry Glacier.

Bryum alpinum L., var. **denticulatum** Card. et Ther., n. var. A forme typica differt habitu graciliore, foliis ovato-acuminatis, brevioribus, marginibus parum revolutis, superne distincte sinuato-denticulatis, costaque longe ab apice dissoluta. On the way from Holzinger's Basin to the Rim.

"**Pseudoleskea radicosa** (Mull.) Lesq. & James. This species was distributed as **P. regiscens** Lindb.: it is the **P. atrovirens** of European authors. Best det. Holzinger's Basin; Mt. Trilby. No. 46.

"**Pseudoleskea denudata Holzingeri** Best. in Bull. Torr. Bot. Club 27:229, May 1900. Holzinger's Basin, Mt. Trilby, Avalanche Basin.

"**Hypnum Cardoti** Ther., sp, nova. Polygamum, olivaceo-viride, molle, laxiuscule depresso-caespitosum. Caulis procumbens vel ascendens, irregulariter ramosus, 2-4 cm. longus. Folia remotiuscula, patulosquarrosa, interdum subsecunda, e basi constricta anguste decurrente late ovate-deltoidea, subito in acumen angustum breviusculum recurvum protracta, circa 1.5 mm. longa et o.75 lata, marginibus planis fere undique sinuato-denticulatis, costa simplici-bifurcata vel gemella, crure longiore ad medium producto, cellulis laxiusculis linearibus subflexuosis, basilaribus brevioribus et latioribus, alaribus laxis majoribus subhyalinis. Folia perichaetialia externa ovato-lanceolata, breviter acuminata, subintegra, enervia, intima plicata, costata. Capsula in pedicello rubente valde flexuoso, circa 18 mm. longo, subhorizontalis, arcuata, operculo convexo apiculato. This species is near **H. stellatum** Schreb. and **H. polygamum** Sch. From the first it is at once distinguished by the polygamous inflorescence and the softer leaves with a shorter acumen and a looser areolation. The shape of the stem leaves and of the perichaetical leaves distinguishes it from the small forms of the second species. Avalanche Basin.

"**Hypnum fluitans** L., var. **brachydictyon** Ren. in Husnot Musc. Gall., forma **Holzingeri** Ren. Voisin de la var. **brachydictyon** Renauld, n'en differe que par le port plus grele, la nervure plus etroite, et el tissu delicat. Dioiquell. Cette var., essentiellement alpine, n'avait pas encore, je crois, ete signalee

en Amerique. A cause de la brievete des cellules medianes, on pourrait confondre cette forme avec **Hypnum aduncum** Hedw.; mais le passage **brusque des cellules foliaires de la base aux** cellules superficielles de la tige permet d' eviter la confusion. Base of Sperry Glacier.

"**Hypnum ochraceum uncinatum** Milde. A European alpine moss, new to North America. Renauld det. Holzinger's Basin.

"**Hypnum uncinatum** Hedw., var. **subjulaceum** Sch., forma **Holzingeri** Ren. Forme voisine de la forme **orthothecioides** Lindb.; en differe par la couleur verte, les touffes compactes encombrees de terre a la base, l'acumen plus court denticule et le tissu plus delicat, non paisse. Base of Sperry Glacier.

Minor extensions of range will be noted in a fuller report on this collection."—John M. Holzinger, Winona, Minn. Bot. Gaz., Aug., 1900, pp. 122-125.

HEPATICAE, LIVERWORTS.

This list is furnished by J. M. Holzinger of the Minnesota State Normal. Determined by Dr. A. W. Evans.

Asterella gracilis (Web.) Underwood. Sperry Glacier (Jones).

Anthelia julacea (Lightf.) Spruce. Sperry Glacier (Jones).

Blepharostoma trichophyllum (L.) Dumort. Holzinger Basin and Mt. Trilby.

Cephalozia bicuspidata (L.) Dumort. Shores of Lake McDonald, Sperry Glacier region.

Cephalozia media Lindb. Shores of Lake McDonald and Sperry Glacier region.

Chiloschypus polyanthos (L.) Corda. Mostly the var. rivularis Neck. Holzinger Basin and Lake McDonald, Sperry Glacier region.

Gymnomitrium obtusum (Lindb.) Pearson. This species has been reported from Greenland only in America. Mt. Trilby.

Harpanthus flutonianus Nees. A few stems only were found mixed with Scaphania undulata. Holzinger Basin.

Jungermannia barbata Schreb. Shores of Lake McDonald, Sperry Glacier region.

Jungermannia Floerkei Web. & Mohr. Holzinger Basin.

Jungermannia lycopodioides Wallr. Holzinger Basin and Avalanche Basin.

Jungermannia ventricosa Dicks. Very variable and common throughout the Sperry Glacier region.

Jungermannia cordifolia Hook. Blackfoot Glacier (Jones).

Lepidozia reptans (L.) Dum. Shores of Lake McDonald and Mt. Trilby.

Marsupella sphacelata (Gieseke) Dum. Shores of Lake McDonald, Sperry Glacier region.

Metzgeria pubescens (Schrank) Raddi. Avalanche Basin, Holzinger Basin and Lake McDonald.

Porella rivularis (Nees) Trevis. Avalanche Basin, Mt. Trilby and shores of Lake McDonald. Also Bigfork (Jones).

Ptilidium ciliare (L.) Nees. Common at all stations.

Ptilidium Californicum (Aust.) Pearson. Mt. Trilby the eastermost station of the species.

Radula complanata (L.) Dumort. Avalanche Basin, Holzinger Basin, and shores of Lake McDonald.

Scapania nemorosa (L.) Dumort. Shores of Lake McDonald, Sperry Glacier region.

Scapania undulata (L.) Dumort. Holzinger Basin and shores of Lake McDonald.

Marchantia polymorpha L. Belton (Jones).

Pleuroclada albescens (Nees) Spruce. Sperry Glacier (Jones).

In addition to the Hepaticae given above there were found specimens of a sterile **Anthelia**, and of a sterile **Nardia** or **Aplozia**.

LICHENS.

During the past season no attempt was made to collect lichens, though a few were picked up here and there. The following list is taken mostly from Bulletin No. 19 Biological Series No. 7 of the University, published by Wilson P. Harris and Carolyh W. Harris, as a result of botanizing in this region in 1901, mostly, together with other species collected by Prof. M. J. Elrod. Plants of the Middle Temperate life zones if not otherwise stated.

Acolium tympanellum (Ach.) De Not. Bigfork, Rost and Echo Lakes.

Alectoria jubata (L.) 9815 Jones. Swan Lake.

Alectoria jubata var. **chalybeiformis** Ach. O'Keefe canon.

Alectoria ochroleuca (Ehrh.) var. **rigida** Fr. O'Keefe canon.

Alectoria ochroleuca var. sarmentosa Nyl. Rost Lake, Sinyaleamin Lake. Craig Mt. where it is subalpine. MacDougal Peak Elrod, Jones also.

Alectoria Fremontii Tuck. Sinyaleamin Lake, Missoula (Elrod). This is the common black moss, which is particularly abundant on forests at high elevation.

Baeomyces aeruginosus (Scop.) DC. Wolf Creek and Craig Mt. The latter alpine.

Biatora Paddensis Tuck. O'Keefe canon and Rost Lake.

Biatora decipiens (Ehrh.) Fr. Mission Mts.

Biatora rufonigra Tuck. Silloway Peak, alpine.

Buellia petraea (Flot. Koerb) Tuck. var. **Montagnoei Tuck.** On rocks. Missoula (Elrod).

Buellia geographica (L.) Tuck. McDonald Lake in the Mission Mountains.

Buellia oidalea Tuck. Rost Lake.

Calicium quercinum Pers. Echo Lake.

Cetraria platyphylla Tuck. O'Keefe canon, Sinyaleamin Lake, Lolo Hot Springs (Elrod). First two localities Middle Temperate.

Cetraria ciliaris (Ach.) Tuck. Lolo Hot Springs (Elrod).

Cetraria glauca (L.) Ach. O'Keefe canon, McDonald Lake in the Mission Mountains, Mud Creek, Swan Lake, Sinyaleamin Lake. Also Lolo Hot Springs (Elrod), (9817 Jones) Swan Lake.

Cetraria Juniperina (L.) Ach. Sinyaleamin Lake, Swan Lake. Also Lolo Hot Springs (Elrod).

Cladonia amaurocraea (Ll.) Schaer. McDonald Lake Mission Mountains.

Cladonia caespiticia (Pers.) Fl. Silloway Peak, alpine.

Cladonia amaurocraea (L.) Schaer. McDonald Lake Mission Mountanns.

Cladonia crispata var. infundibulifera (Schaer.) Wahl. McDonald Lake in Mission Mountains.

Cladonia coccifera var. **pleurota** (Flk.) Willd. McDonald Lake, Mission Mts.

Cladonia cornuta (L.) Fr. McDonald Lake, Mission Mountains.

Cladonia deformis (L.) Hoffm. Sinyaleamin Lake.

Cladonia digitata (L.) Hoffm. Flathead Lake.

Cladonia fimbriata (L.) Fr. Flathead Lake and Lolo Hot Springs (Elrod) on decaying logs. Swan Lake, Jones.

Cladonia fimbriata var. **radiata** Fr. Missoula (Elrod).

Cladonia fimbriata var. **tubaeformis** Mud Creek.

Cladonia gracilis var. **verticillata** Fr. Sinyaleamin Lake.

Cladonia gracilis var. **symphycarpia** Tuck. Sinyaleamin Lake, McDonald Lake, Mission Mountains. Also Missoula (Elrod).

Cladonia gracilescens (Rab.) Waimo. Rare in N. A.

Cladonia pyxidata (L.) Fr. State Station on Flathead Lake eastern side Bigfork, McDonald Lake. Also Flathead Lake and Missoula (Elrod). Sperry Glacier, Lake McDonald, Jones.

Cladonia turgida var. **conspicua** (Schaer) Nyl. Lolo Hot Springs (Elrod).

Cladonia rangifera var. **sylvatica** L. Sinyaleamin Lake, and McDonald Lake. Also Flathead Lake (Elrod).

Cladonia sylvatica (L). Hoffm. McDonald Lake in the Mission Mountains, Jones.

Endocarpon miniatum Ach. Sentinel Mt.

Evernia vulpina (L.) Ach. Sentinel Mt. and Sinyaleamin Lake. Also Flathead Lake (Elrod). This is a very common and beautiful yellow lichen. Also (7911 Jones) MacDougal Peak, subalpine.

Lecanora atrata (Huds.) Ach. Flathead Lake and Rost Lake.

Lecanora cervina var. **cinerevella** Fink. Craig Mountain. Alpine.

Lecanora pallescens (L.) Ach. Missoula, growing on mosses.

Lecanora chlorophana (Wahl.) Ach. Craig Mountain. Alpine.

Lecanora punicea Ach. Rost Lake.

Lecanora rubina (Vill.) Ach. Mt. Sentinel. Also Missoula (Elrod).

Lecanora subfusca (L.) Ach. Flathead Lake and Post Creek.

Lecanora xanthophana var. **dealbata** Tuck. Craig Mountain. Alpine.

Leptogium sp. Missoula (Elrod).

Parmelia conspersa (Ehrh.) Ach. Post Creek and McDonald Lake in the Mission Mountains. Also Missoula (Elrod).

Parmelia olivacea (L.) Ach. Mt. Sentinel, St. Ignatius Mission and Post Creek.

Parmelia physodes (L.) Ach. Lolo Hot Springs (Elrod).

Parmelia physodes var. **vittata** Ach.Mt. Sentinel, Sinyaleamin Lake. Also Lolo Hot Springs (Elrod).

Parmelia physodes var. **enteromorpha** Tuck. Lolo Hot Springs (Elrod).

Parmelia saxatilis (L.) Fr. Sinyaleamin Lake. Also Flathead Lake (Elrod).

Parmelia saxatilis var. **sulcata** Nyl. O'Keefe canon and McDonald Lake. Also Lolo Hot Springs (Elrod).

Peltigera aphthosa (L.) Hoffm. Sinyaleamin Lake. Also Missoula, Lolo Hot Springs and Flathead Lake (Elrod). Also (7914 Jones) Bigfork.

Peltigera canina (L.) Hoffm. Sinyaleamin Lake, O'Keefe canon and McDonald Lake in the Mission Mountains. Also Flathead Lake and Missoula (Elrod). Alta.

Peltigera venosa (L.) Hoffm. Bigfork.

Placodium elegans (Link) De. McDonald Lake. Also Missoula and Elrod Peak (Elrod). Sperry Glacier, Jones.

Physcia stellaris (L.) Tuck. St. Ignatius Mission.

Physcia stellaris var. **aipolia** Nyl. Flathead Lake.

Rinodeina oreina (Ach.) Mass. Missoula (Elrod).

Ramalina calicaris var. **fastigiata** Flathead Lake.

Solorina crocea (L.) Sch. Sperry Glacier, Jones.

Stereocaulum alpinum Th. Fr. Sperry Glacier. Rare in North America. Jones.

Sticta pulmonaris (L.) Ach. Mud Creek and McDonald Lake in the Mission Mountains.

Theloschistes Lychnens (Nyl.) Tuck. Bigfork. Also Missoula (Elrod).

Umbelicaria hyperborea Hoffm. McDonald Lake, Mission Mts.

Umbilicaria phaea Tuck. McDonald Lake, Mission Mts.

Umbilicaria vellea (L.) Nyl. McDonald Lake, Mission Mountains. Also Lolo Hot Springs (Elrod).

Usnea barbata (L.) Fr. Mt. Sentinel and Mud Creek. Also Flathead Lake (Elrod).

Usnea barbata var. **hirta** Mt. Sentinel

Usnea cavernosa Tuck. McDonald Lake, Mission Mts.

All my species of lichens have been identified by Prof. Bruce Fink, and are given as collected by myself. Those without collectors' names, were gathered by Harris.

ALGAE.

Ricciocarpus natans. Jeff's Cabin, Swan River, Jones. Identified by Prof. Setchell.

FUNGI.

So far as can be learned there have been but two attempts to collect the fungi on living leaves in our region. No attempt having been made so far to get the immense number growing on dead stems and the ground. A few of these have been picked up incidentally only.

Prin. T. A. Bonser now of the Spokane High School, seems to have made the first collections during his work at the Biological Station. His plants were identified by Prof. Farlow. His list covers 50 species and is embraced in this report.

During the past season I attempted to get all the Fungi on living leaves in the Flathead region. Some were missed doubtless but most of them were found. My list embraces considerably over 100 species. All my plants were identified by Chas. Peck, Esq., of Albany, New York, and Prof. J. C. Arthur of Purdue University, the latter identifications being rusts mostly.

In the descriptions of dimensions of spores "m" stands for thousands of a millimeter (in the absence of the proper sign).

Actinomena Rosae (Li.) Fr. On Rosa gymnocarpa. Dayton.

Aecidium abundans Peck. On Symphoricarpos oreophilus. Lima.

Aecidium Alleni Clint. On Shepherdia Canadensis. Wild Horse Island. Also on the same host by Bonser in Swan river valley. On Elaeagnus argenteus near Dayton. It is very rarely found on this host.

Aecidium Berberidis Pers. Wild Horse Island and Yellow Bay. On Berberis repens.

Aecidium Ranunculacearum DC. On Ranunculus glaberrimus. Lima.

Aecidium Thalictri Grev. On Thalictrum occidentale. MacDougal Peak (Bonser). Also by Jones on MacDougal Peak.

Aecidium cornutum. On Amelanchier alnifolia. Bigfork (Bonser).

Aecidium cornutum. On Amelanchier alinfolia. Bigfork (Bonser).

Agyrium elongatum (E. & E.). On dead stems of Valeriana, MacDougal Peak (Bonser).

Albugo candida (Pers.) Kuntze. On Capsella Bursa-pastoris. Bigfork.

Albugo Bliti (Biv.) Kuntze. On Amarantus blitoides. Bigfork.

Albugo. On Pentstemon confertus. Whitewater.

Ascochyta colorata Peck. On Fragaria vesca. Bigfork.

Caeoma. On Rubus Nutkana. Bigfork (Bonser).

Calyptospora columnaris (A. & S.) Kuhn. On Vaccinium Myrtillus var. microphyllum MacDougal Peak. Alpine.

Cronartium Comandrae Peck. On Comandra pallida at Wild Horse Island and Yellow Bay. Also by Elrod.

Chrysomixa Pyrolae (DC.) Rostr. On Pyrola rotundifolia. Swan river valley (Bonser).

Coleosporium Asteris. On Aster. Swan river valley (Bonser).

Coleosporium Solidaginis (Schw.) Thun. Probably includes C. Asteris. On Aster leaves at Wild Horse Island, Big Arm, Bigfork and MacDougal Peak. Also on Solidago, Swan river valley (Bonser).

Cylindrosporium simile Peck, n. sp. Maculae parvae, paucae sparsaeque vel numerosae et saepe confluentes, angulares, pallidae; acervuli in macula quavis unus multive, plerumque epiphylli, pulvinati vel plerumque nucleatae, brunnei; sporae filiformes, curvatae, continuae, hylinae, plerumque nucleatae, 40-80 x 4 m. (.0016-.0032 unciae longae, .00016 unciae latae). On living leaves of Ceanothus sanguineus. Bigfork and MacDougal Peak, Flathead Lake, Montana, August, Jones. Allied to C. Ceanothi E. & E., from which it differs in the color of the spots and in the longer continuous spores.

Cylindrosporium simile var. **Pruninum** Peck, n. var. Maculae minores, saepe coloratiores; sporae breviores, 30-60 m; **basidia longior 15-25 m. In foliis Pruni emarginatae. Yellow Bay on Flathead Lake at 4000° alt. on the slope of the Mission Mts. Some bushes of Prunus emarginata were almost** covered with the fungus.

Cystopus candidus (Pers.) Lev. On Cardamine hirsuta. McDonald Lake in the Mission Mountains.

Dimerosporium Collinsii (Schew.) Thum. On Amelanchier alnifolia at Bigfork. This is very abundant and seems to be affecting the fruit trees very injuriously.

Doassansia Sagittariae (West) Fisch. On Sagittaria arifolia at Swan Lake.

Doassansia Alismatis (Nees) Corn. On Alisma Plantago at Swan Lake.

Dothidea Pteridis, Phyllachora, Cryptomyces, all stages of the same fungus. On Pteris aquilina. Bigfork (Bonser). Probably the same as Uredinopsis Pteridis Diet. & Holway which I also got at the foot of MacDougal Peak on the same host.

Erineum. This was once supposed to be a fungus but now is regarded as a disease caused by mites. On Acer glabrum at Bigfork. Common.

Erysiphe Polygoni DC. On Polygonum aviculare at Wild Horse Island.

Erysiphe Polygoni var. On Lupinus at Bigfork(Bonser).

Gymnosporangium Nelsoni Arthur. On Amelanchier alnifolia at Yellow Bay.

Hydnum. The coral fungus. This was scarce but very beautiful. Polson.

Linospora Brunellae E. &. E. OnBrunella vulgaris at Swan Lake.

Marssonsia Potentillae (Desm.) Fisch. On Potentilla on Nigger Prairie Trail. Bonser.

Melampsora Medusae Thum. This is the same as Uredo Medusae (Thum.) Arthur. On Populus trichocarpa at Bigfork by Bonsor, and by myself on Populus tremuloides at Bigfork.

Melampsora Bigelovii. On Salix at Bigfork by Bonser.

Melampsoridium Betulae (Schum.) Arthur. On Betula glandulosa at MacDougal Peak. Also on B. alba at Dayton.

Melampsoropsis Pyrolae (D.C.) Arfthur. On Pyrola rotundifolia at Bigfork. This is probably the same ac Chrysomixa reported above by Bonser.

Microsphaeria Alni (Wallr.) On Vicia Americana at Bigfork by Bonser.

Microsphaeria Alni var. ludens. Salm. On Vicia Americana at Big Arm.

Microsphaeria Alni var. divaricata. On Ceanothus sangunieus at Bigfork by Bonser.

Microsphaeria diffusa C. & P. On Symphoricarpos racemosus at Bigfork. Also on the same host and locality by Bonser.

Peridermium Balsameum Peck. On Abies grandis at Swan Lake and MacDougal Peak and Yellow Bay.

Peridermium pseudo-balsameum (Holway). On Abies grandis at Bigfork by Bonser.

Peridermium ornamentale Arthur. On Abies lasiocarpa at MacDougal Peak, alpine.

Peridermium Pini. On Pinus ponderosa at Bigfork by Bonser.

Phragmidium affine Sydow. On Potentilla flabelliformis at Monida.

Phragmidium occidentale Arthur. On Rubus Nutkana at MacDougal Peak and Bigfork.

Phragmidium "tuberculatum." On Rosa at Bigfork by Bonser.

Phragmidium montivagum Arth. On Rosa gymnocarpa at Bigfork.

Phoma Lupini. On Lupinus on the MacDougal Peak trail, Bonser.

Phoma. On Arctostaphylos Uva-Ursi at Bigfork by Bonser.

Phyllosticta Angelicae Sacc. On Angelica Lyallii at Swan Lake.

Phyllosticta Arnicae Fckl. On Arnica cordifolia. Evaro.

Physoderma vagans Schroet. On Sium cicutaefolium at Bigfork.

Podosphaeria oxyacanthae (DC.) DeBary. On Prunus demissa. Ravalli.

Polythelis Thalictri (Chev.) Arthur. This is the same as Puccinia Thalictri Chev. On Thalictrum occidentale on slopes of MacDougal Peak.

Puccinia Absinthii (DC.) On Artemisia Ludoviciana at Polson by Bonser.

Puccinia acuminata Pp. On Cornus Canadensis on Swan river (Bonser).

Puccinia Agropyri E. &. E. On Agropyron divergens at Bigfork.

Puccinia arnicalis Peck. On Arnica cordifolia at Bigfork.

Puccinia Asteris. On Aster at Bigfork by Bonser.

Puccinia Arabis (probably the same as P. Holboellii). On Arabis on Swan river by Bonser.

Puccinia Balsamorhizae Peck. On Balsamorhiza sagittata at Wild Horse Island and Bigfork. Also on the same host at Polson by Bonser.

Puccinia Circaeae Pers. On Circaea Pacificia at Swan Lake and on Circaea alpina at Bigfork. Also on C. Pacifica on Swan river by Bonser.

Puccinia Clarkiae. On Clarkia pulchella at Bigfork (Bonser). Ronan, Jones.

Puccinia Dayi Clint. Not before reported west of the Mississippi Valley. On Steironema ciliatum at Wild Horse Island.

Puccinia Gentianae (Strauss.) Link. On Gentiana affinis at Big Arm.

Puccinia gigantospora Bubak. On Anemone multifida at Monida.

Puccinia graminis. On "grass" at Echo Lake (Bonser).

Puccinia hemispherica (Peck.) E. & E. On Lactuca pulchella at Whitefish.

Puccinia Heucherae (Schew.) Dietr. On Mitella nuda at Bigfork and MacDougal Peak, and on Tiarella unifoliata at Swan Lake. Also on Saxifraga on Swan river by Bonser.

Puccinia Hieracii (Schum.) Mart. On Hieracium Canadense at Bigfork. Also by Bonser on same host and at same locality.

Puccinia Holboellii (Hornem.) Rostr. On Arabis Holboellii at MacDougal Peak in the Upper Temperate life zone.

Puccinia intricata var. **Eriogoni.** On Eriogonum at Flathead Lake by Bonser.

Puccinia Menthae Pers. On Monarda fistulosa at Big Arm, Bigfork and Wild Horse Island, also Mentha Canadensis at Whitefish and Bigfork. Also on Mentha on Swan river by Bonser.

Puccinia melanocoides. On Dodecathon at Monida.

Puccinia mesomegala B. &. C. On Clintonia uniflora at Bigfork and MacDougal Peak. Also at Nigger Prairie on same host by Bonser.

Puccinia Physostegiae P. &. C. On Physostegia parviflora. Not heretofore known west of Indiana.

Puccinia Polygoni-amphibii. On Polygonum at Swan Lake by Bonser.

Puccinia pulverulenta Crev. On Epilobium adenocaulon at St. Ignatius Mission.

Puccinia punctata. On Galium boreale at Bigfork by Bonser.

Puccinia recedens Syd. On Senecio balsamitae at Swan Lake.

Puccinia subnitens Diet. On Distichlis spicata at the Hot Springs.

Puccinia Symphoricarpi Hark. On Symphoricarpos racemosus at MacDougal Peak and Swan Lake. Also by Bonser at Bigfork on same host.

Puccinia Troximontis Peck. On Troximon grandiflorum at Wild Horse Island.

Puccinia Violae (Schum.) DC. On Viola Canadensis at Dayton and Bigfork and on V. canina at MacDougal Peak.

Puccinia. On berberis repens at Yellow Bay and Wild Horse Island. See Aecidium.

Puccinia. On Thalictrum occidentale at MacDougal Peak. See Aecidium.

Puccinia Jonesii Peck. On Leptotaenia filicina. McDonald Lake in the Mission Mountains.

Puccinia Gayophyti Peck. On Gayophytum diffusum. Darby.

Pucciniastrum Myrtilli (Schum.) Arthur. On Vaccinium myrtilloides at Yellow Bay and Bigfork. On Vaccinium Myrtillus var. microphyllum at MacDougal Peak, where it is subalpine. Also on Vaccinium on Hall's Peak by Bonser.

Pucciniastrum pustulatum (Pers.) Diet. On Epilobium spicatum at Bigfork on Epilobium adenocaulon at Bigfork. Also on Epilobium at Echo Lake by Bonser.

Pucciniastrum Pyrolae (Pers.) Diet. On Pyrola secunda at Yellow Bay. Also on Pyrola on Swan river by Bonser.

Pyrenophora fenestrata Peck. On Dead stems of Astragalus Bourgovii, MacDougal Peak.

Rhytisma Arbuti Phill. On Menziesia glabella at Hall's Peak, Bonser. Also by Jones on same host at MacDougal Peak and Bigfork.

Roestelia tubulata Kern n. sp.

Pycnils epiphyllis, numerosis, in greges irregulares dense confertis, maculis decoloratis insidentibus, cylindraceis. 2-3.5 mm. altis, 0-0.4 mm. diam., apice persistentes cohaerentibus; peridio firmo; cellulis peridiis fusoideo-oblongis, 17-25 m x 48-80 m, rugoso; aeciosporis globosis vel subglobosis, 18-22 m x 21-28 m; episporio castaneo-brunneo, 1.5-2.5 m. crasso, subtiliter verruculoso; poris germinantionis 6-8, sine ordine dispersis.

Habitat in foliis Crataegi Douglasii Lindley. Polson prope Flathead Lake in Montana Americae bor. 840 m. alt. Aug. 19 1908. Coll. Marcus E. Jones.

This species is characterized by its firm tube-like peridium which does not rupture at the apex but by longitudinal slits in the lower part. In its firmness and in its tendency to maintain its tubular form without becoming lacerate above it has a resemblance to Roestelia cornuta (Pers.) Fries on Sorbus. It differs from that species, however, in its more slender peridia, and in the size and surface-marking of the peridial cells. The peridial cells have a considerable resemblance to those of Roestelia globosa Farl. but it is very much unlike that species in the size of the peridia and in their manner of rupturing.

Roestelia Nelsoni Arthur. On Amelanchier alnifolia at Bigfork.

Roestelia tubulata Kern. On Crataegus allied to coccineus at Polson. On Crataegus Douglasii at Bigfork.

Roestelia cornuta Ellis. On Pyrus "Sitchensis" at Hall's Peak.

Septoria saccharina var. **occidentalis** E. &. E. On Acer glabrum at Yellow Bay, Bigfork and MacDougal Peak.

Septoria sorbi Lasch. On Pyrus sambucifolia at Yellow Bay and Bigfork. On P. "Americana" at MacDougal Peak, alpine.

Septoria salicifoliae. On Spiraea at Bigfork by Bonser.

Septoria Streptopidis Peck n. sp. Maculae subangulares, 2-8 mm. (x 1-4 mm.) latae saepe confluentes flavidae, brunneae vel rubrobunneae; perithecia amphigena, membranacea, inaequalia, atra, in macula quavis unum multave; sporae numerosae, elongatae, cylindraceae vel subfiliformes, curvatae, plurinucleatae, 30-89 x 4-5 m., ex perithecia exudantes et massam albidam formantes. On living leaves of Streptopus roseus and Prosartes trachycarpa at Yellow Bay, Swan Lake, MacDougal Peak and Bigfork.

Sphaerella Chimaphilae (E. & E.). On Chimaphila umbellata at Bigfork by Bonser.

Sphaerotheca Humuli (DC.) Burr. On Sium cicutaaefolium at Bigfork.

Triphragmium clavellum. On Aralia at Swan Lake by Bonser.

Thecaspora deformans Dur. & Mort. On Rubus Idaeus. Whitefish. On Astragalus flexuosus, Browning.

Uncinula Salicis. On Salix at Flathead Lake by Bonser.

Uredo confluens Pers. On Salix Scouleriana at Bigfork.

Uredo Lini Schum. On Linum Lewisii at Wild Horse Island.

Uredo Medusae (Thum.) Arthur. On Populus tremuloides at Bigfork .

Uredo Bigelovii (Thum.) Arth. On Vaccinium. Sperry Glacier, Alta.

Uredo Polypodii DC. On Cystopteris fragilis. Blackfoot Glacier.

Uromyces albus D. & H. On Vicia Americana at MacDougal Peak.

Uromyces Aristidae E. &. E. On Plantago Tweedyi in Deer Lodge Valley.

Uromyces Astragali (Opiz.) Schroet. On Oxytropis albiflorus at Wild Horse Island.

Uromyces Erythronii (DC.) Lev. On Erythronium grandiflorum var, minus at MacDougal Peak, alpine.

Uromyces Euphorbiae C. & P. On Euphorbia serpyllifolia at St. Ignatius Mission.

Uromyces fabae (P.) Schroet. On Lathyrus "parvifolius" at Echo Lake by Bonser.

Uromyces Glycyrrhizae Magn. On Glycyrrhiza lepidota at Dayton and Wild Horse Island.

Uromyces Hedysari-obscuri. On Hedysarum flavescens at MacDougal Peak by Elrod.

Uromyces unitus Peck. On Lewisia rediviva at Missoula.

Uromyces borealis Peck. On Hedysarum sulphurescens. Como Peak, Browning, Blackfoot Glacier.

Uromyces Astragali (Opiz.) Sacc. On Astragalus alpinus. Bigfork.

Ustilago Mulfordiana. On Festuca tenella at Kalispell by Bonser.

Ustilago bromivora (Tul.) Fisch. On Bromus secalinus at Wild Horse Island. On Bromus Pumpellianus at Bigfork. On Stipa comata at Bigfork.

Ustilago. On Carex nardina. Sperry Glacier, also Carex atrofusca in the Mission Mountains.

Uredinopsis Pteridis Diet. & Holway. On Pteris aquilina at MacDougal Peak.

Uredinopsis Struthiopteridis Storm. On Aspidium Filix-Mas at MacDougal Peak. "This gives a new host for the species, and also greatly extends the range. Heretofore has been known only from Vermont and Newfoundland." Arthur.

Uropyxis sanguinea (Peck) Arthur. On Berberis repens at Yellow Bay, Wild Horse Island and MacDougal Peak.

Besides the above fungi the following were gathered but not in determinable condition.

On Prosartes rosea. Bigfork.
On Echinospermum. MacDougal Peak.
On Saxifraga punctata. McDonald Peak.
On Ribes lacustre. Bigfork.
On Parnassia fimbriata. Bigfork.
On Poterium. St. Ignatius Mission.
On Smilacina sessilifolia. Bigfork.
On Petasites. Whitefish.
On Galium boreale. Wild Horse Island.
On Leptotaenia filicina. Wild Horse Island.
On Spiraea. Bigfork.
On Hedysarum flavescens. MacDougal Peak.
On Vicia Americana. Whitefish.
On Astragalus leptaleus. Big Arm.
On Anemone nemorosa. MacDougal Peak.
On Poa alpina dead leaves. MacDougal Peak.
On Habenaria dilatata. Yellow Bay.
On Juncus Balticus. Monida.
On Juncus Mertensianus. MacDougal Peak.

LOCALITIES.

Alta, a station at the head of Bitter Root Valley.

Avalanche Basin, below Sperry Glacier.

Bigfork, the location of the University of Montana Biological Station, at the outlet of Swan River into Flathead Lake.

Blackfoot Glacier, on the north slope of Blackfoot and the south and east slopes of Jackson Mountains main range of the Rockies, the drainage into St. Mary's Lake, and the Hudson Bay drainage.

Belton, on the Great Northern railway, on the Middle Fork of Flathead River.

Bull Island, one of the chain of islands in the lower portion of Flathead Lake.

Browning, on the Great Northern railway, Blackfoot Indian Reservation.

Big Arm, the large western projection of Flathead Lake.

Como Peak, in the Bitter Root Mountains, opposite the postoffice Como.

Colville.

Darby, a town in the upper Bitter Root valley.

Dayton, postoffice at the Big Arm of Flathead Lake.

Daphnia Pond, at Bigfork, upper end of Flathead Lake.

Durant, railroad junction 15 miles east of Anaconda.

Elrod Peak, between the South and Middle Forks of Flathead River, one of a series of bald crags of yellow argillite, the waters from the north glacier flowing into Stanton Lake, from the west, forming creek which flows into the South Fork. Elevation 9,500 feet.

Evaro, station on the Northern Pacific railroad, summit or pass in the Cabinet Mountains, 16 miles from Missoula.

Echo Lake, a small lake in the wooded valley west of the Swan Range, near Bigfork.

Edwards, Mt., touching Sperry Glacier on the southwest.

Flathead Delta, upper or northern end of Flathead Lake, where Flathead River enters. The delta is formed by the old and present channels of the river.

Gunsight Pass, over the main Rockies between Gunsight and Jackson Mountains.

Gunsight Lake, between Gunsight and Jackson Mountains, on the Hudson Bay side, along the trail over Gunsight Pass.

Garrison, town on the Northern Pacific railroad, junction of Deer Lodge and Little Blackfoot Rivers.

Hot Springs, on Flathead Reservation, 35 miles west of Polson, and 25 miles from Plains, the former at the foot of Flathead Lake, the latter on the Northern Pacific railroad.

Haggin, Mount, south of Anaconda, continental divide.

Holzinger Basin, at an elevation of about 6,500 feet, along the trail from McDonald Lake to Sperry Glacier up Snyder Creek.

Jordan Lakes, two small lakes on the southwestern slope of McDonald Peak in the Mission Mountains, not far from Mission Valley proper.

Lambert Valley. A small valley at higher elevation (7,000 feet) in the Mission Mountains, on the south side of Mission Creek, back of (east of) the high unnamed peak next to Mission Valley.

Little Bitter Root, river and valley, in Flathead Indian Reservation. The valley is the old river valley which was the former outlet of Flathead Lake.

Lincoln Pass, on the trail from Lake McDonald to Gunsight, pass between Gunsight and Lincoln Peaks.

Little Matterhorn, a sharp point of rocks at foot of Sperry Glacier, jutting out from Edwards.

Lake McDonald, a few miles from Belton on the Great Northern railroad, 12 miles long and about two miles wide; not to be confused with McDonald Lake in the Mission Mountains, 80 or 90 miles further south.

Lake Louise, between Gunsight and Jackson Mountains, along Gunsight trail. Elevation about 6,000 feet.

Lo Lo Mountains, southwest of Missoula, 9,500 feet elevation.

MacDougal Peak, in the Swan Range, over the shoulder of which the old Aeneas trail leads. Elevation 7,600 feet.

Mission Creek, in the Mission Mountains, heading in immense snowfields, flowing westward past St. Ignatius, emptying into the Pend d'Oreille River.

McDonald Peak, Mission Mountains, elevation 10,100 feet.

Monida, on the summit between Montana and Idaho, on the O. R. and N. railway.

Mud Creek, heading in the Mission Mountains, flowing westward across Mission Valley in Flathead Indian Reservation.

Nigger Prairie, an opening in the woods east of Bigfork, some new mines.

O'Keefe Canyon, about eight miles northwest of Missoula.

Polson, a town at the foot of Flathead Lake.

Polson Swamp, near Polson.

Ravalli, on the Northern Pacific railroad, Flathead Indian Reservation, 37 miles from Missoula.

Ronan, town on Flathead Reservation, in Mission Valley.

Rost Lake, a small lake a mile in diameter, in the timber at the foot of MacDougal Peak, Swan Range, Flathead Valley.

Ryan's Lake, on the slopes of Mt. Powell, Deer Lodge valley.

Rexford, a station on the Great Northern near the Canadian line, west of Whitefish.

Rim, the, rock cliff at the end of trail up Snyder Creek, at the southern edge of ice of Sperry Glacier.

Sperry Glacier, resting on the western slope of the main Rockies in a depression between Gunsight and Edwards Peaks, reached by trail from Lake McDonald either from the south side, easily, or with more difficulty by trail up Avalanche Basin.

Silloway Peak, in the Swan Range, a few miles south and a little east of MacDougal Peak, with triple summit, the highest 7,600 feet.

Swan Lake, between Mission and Swan Ranges, twelve miles long, an expansion of Swan River.

St. Ignatius, on Flathead Reservation, in Mission Valley.

Stanton Lake, three miles west of Great Northern railway, near Nyack.

Silver Bow, railway junction near Butte.

Somers, town on the northwest corner Flathead Lake.

Schultze's Cabin, a point on the Aeneas trail from Flathead Lake across Swan Range, the farthest point to which wagons may be taken.

Stanton, Mt., at upper end of Lake McDonald, northwest of the lake.

Sentinel, Mt., also called University Mountain, just east of the University of Montana campus at Missoula.

Thompson Falls, a town in Western Montana, near the state line, on the Northern Pacific railroad.

Trail Creek, a creek on the eastern face of the Swan Range, just north of MacDougal Peak, flowing into the South Fork of Flathead River..

Wild Horse Island, large island in the western or Big Arm of Flathead Lake.

Whitefish, on the Great Northern railroad, near Kalispell.

Whitewater.

Yellow Bay, on the eastern side of Flathead Lake, midway.

ADDENDA.

Since the preceding was set in type the following notes on species and descriptions of new species have been prepared, and are inserted.

The following notes may help to clear up the relationships of two sedges in our region. William Boott first separated one species and Bailey the other. Boott in his description of C. luzulaefolia confounded the two species, as they grow together in the Sierras. This is shown by the names he gave to my material. Mackenzie has also tried to separate the Nevada form of ablata which verges toward C. luzulaefolia, but it is not distinct.

Common characters are Upper spikelets sessile or nearly so, not linear, the lower mostly clavate, on elongated and filiform peduncles. Perigynia green or rusty with age, slightly inflated, the lanceolate, body nearly filled by the seed, with triangular and substipitate base, and tapering into a flat triangular beak which is scabrous and papillose and deeply 2-toothed and purple-striped down the middle, the upper half empty, a little inflated, papery, strongly nerved on the sides and faintly nerved on the face, green till mature, not less than 4 mm. long, a little longer than the scale, spreading. Bracts green and leaf-like, shorter or little longer than the blade, not as long as its sheath which is light colored and with rusty ring at tip. Sheaths widening a little above. Leaves many, broad and flat, 3-9 mm. wide, shortly acuminate, yellowish, smooth, rarely more than 1-2 dm. long, gradually reduced above along the stems to bracts, the central sheaths often 1 dm. long, the upper bracteal ones barely less than 2 cm. long. Stems at base clothed with coarse leaf fibers, often 8 mm. thick, gradually tapering at tip to almost filiform, about 3 feet high and erect, few together from very shortly stoloniferous rootstacks often 1 cm. thick. Plants of dry meadows at high elevations.

Luzulaefolia W. Boott Bot. Cal. 2 250 (1880), in part. C. fissuricola Mackenzie, (Luzula-leaved Sedge.) Spikelets 2-3 mm. long, 6-9 mm. wide, the upper ones clustered and nearly sessile. Perigynia 6 mm. long and 2 mm. wide, punctate and slightly granulated above, straight, beak about half the whole, green or rusty only. Scales dark-brown with light center, scarious margin hardly any and strong midrib going to the tip or projecting as a short awn or mucro. Leaves 4-9 mm. wide, shortly acuminate, quickly reduced to scales at base of stems. Wasatch mountains, Utah, westward and northward.

Oblata Bailey. Bot. Gaz. 13 82 (1888) (oblate Sedge). Spikelets 1-2 cm. long, the sterile 7-15 mm. long and often compound, 2-8 mm. wide, sometimes fertile in the middle, mostly clavate; fertile ones club-shaped, 1-2 cm. long, 3-6 mm. wide, only the uppermost one sessile, the rest on variously elongated peduncles, dark-brown. Perigynia with beak about ⅓ the whole, smooth, about 3 mm. long, and 2 mm. wide, with recurved tip. Scales purple with light center, ovate to oblong, obtuse, ovate to oblong, with broad hyaline and white and lacerate margins and tip, the midrib not reaching the tip. Leaves about 3 mm. wide, long-acuminate, rarely at all reduced below. Rather common in the Sierras. This probably includes C. herbariorum. First published as ablata, but intended for oblata. The Utah forms referred here are better placed in luzulaefolia. Kukenthal is probably right in placing this as a variety of luzulaefolia, since the Utah and Nevada material has sharp scales and less hyaline and longer perigynia.

Two other sedges on which our field work throws much light are Montanensis and Tolmiei. They belong to the same group as those above but verging toward the atrata group in the flattening of the perigynia and the reduction of the beak.

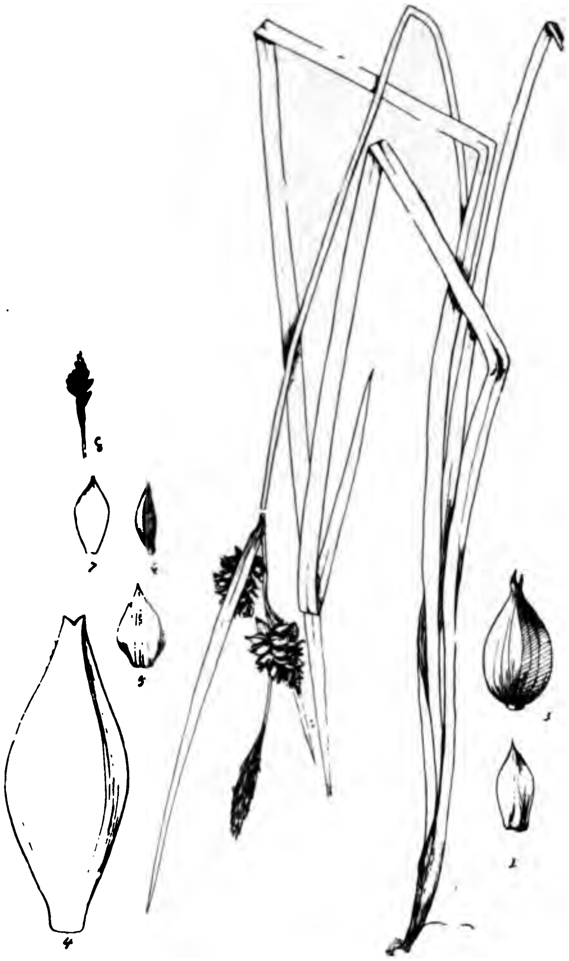
Common characters are: Spikelets purple, from almost black to chestnut colored, small, short, oblanceolate to ovate, compactly flowered, contiguous (or amounting to that by the elongation of the lower peduncles), the staminate single. Perigynia oval-ovate, about 3 mm. long by 2 mm. wide, nearly flat above and triquetrous below, thin and papery, fully twice as large as the smooth seed and empty above, finely punctate when young and granulated when ripe, white when young and nearly black, at least at tip, when old, with two lateral nerves and faint green lines abruptly contracted into the face when young but appearing nerveless, spreading at about 45° angle, sessile, with cylindrical beak about twice as long as wide. Scales very dark with narrow green midrib. Bracts broad and leaf-like, nearly as wide as the leaves with subulate tip, many times longer than the very short sheaths, but not overtopping the stems. Leaves very dark-green, mostly 1-2 dm. long, quickly reduced to chestnut-colored scales below, shortly acuminate, flat and smooth, leathery without fibrillose sheaths. Stems tapering from base to slender tip, 1-1.5 feet high, growing in large clumps from shortly stoloniferous rootstocks which are densely clothed with coarse leaf fibers and appearing as if abruptly decumbent at base, leafy only on the lower third, sharply 3-angled. Plants of alpine meadows, not in wet places.

Carex Tolmiei Boott in Hook. Fl. Bor. Am. 2 224 (1840). (Tolmie's Sedge). All but the lower spikelets sessile and mostly overlapping, mostly oblong-oblanceolate,, rarely oval and then very small, the upper ones conspicuously smaller, the staminate one a little longer and wider than the rest, erect or nearly so. Scales lanceolate, acute, fully as long but a little narrower than the perigynia. Bracts with black auricles, but some of them with very short sheaths. Leaves 3-4 mm. wide. Mt. Powell and Sperry Glacier region. This has all the appearance of a hybrid between C. atrata and C. Montanensis with which it grows.

Carex Montanensis Bailey Bot. Gaz. 17 152 (1892). (Montana Sedge). All Spikelets but perhaps occasionally the uppermost fertile one on capillary and drooping peduncles from half to four times the length of the spikelets, fully developed ones about 2 cm. long and 5 mm. wide, narrowly oblong, the staminate one smaller and oblanceolate to obovate, all the fertile ones about the same length though the uppermost one when sessile is often minute and very few flowered. Scales mostly ovate and barely acute, sometimes lanceolate and acute from half to nearly as long as the perigynia, often entirely purple. Bracts with chestnut-colored auricles and the lowest with sheaths about 1 cm. long. Leaves 2.5-3 mm. wide. Stems mostly densely clustered as if caespitose but the crowns are distinctly separate. This is the most common sedge, having the habit of C. limosa, in all the alpine meadows of nothwestern Montana, and if not the same as C. atrofusca is at least very near it.

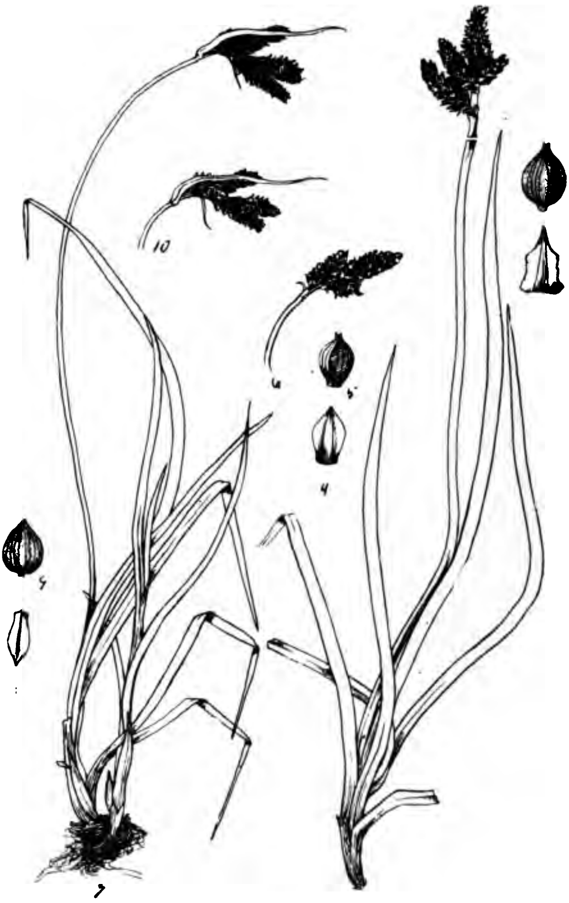
Carex aboriginum n. sp. Stems shortly stoloniferous, rigid, erect, smooth, obtusely 3-angled, finely papillose, about 3 feet high, leafy on the lower third, slender. Leaf sheaths hyaline and not fibrillose. All the leaves about half the stems, not reduced below, flat, 3 mm. wide, long-acuminate, smooth, light-green, bases light colored. Bracts green and subulate pointed, the lower 2-3 dm. long. Spikelets all peduncled, the upper fertile ones very shortly so, the single terminal and staminate one on a filiform peduncle nearly its own length and oblanceolate, about 2 cm. long and 3 mm. wide, fertile spikelets 2-3, nearly contiguous, oval, about 15 mm. long and 12 mm. wide, compactly flowered, the upper flowers spreading and the lower mostly reflexed at maturity by the crowding of the perigynia, about 25-30 flowered, fuscous with age. Perigynia about 6 mm. long and 3 mm. wide, ovate, decidedly inflated, papery, whitish and becoming fuscous when ripe. Somewhat flattened above, triquetrous but with only 2 strong lateral nerves and about 5 finer ones on the faces, finely punctate all over, which becomes almost papillose with age, half filled by the spherical seed, minutely and abruptly stipitate; beak flattened, serrate, papillose, purple, deeply notched and 2-toothed, scarcely more than a triangular prolongation of the perigynia and about as long as wide below. Scales lanceolate, acuminate purplish, with a light center, nearly as long as the perigynia but much narrower, scabrous on the midrib. Stigmas 3.

This grows on dry gumbo soil which is wet in the spring. It has the habit of C. Gmelini and is nearest related to Raynoldsii, though having fruit characters between that and ablata. Indian Valley, Southern Idaho, near Salubria, July 12, 1899. Middle Temperate life zone.



Carex aboriginum, 1, 2, 3.
Carex nardina (from Britton, x9) 4.
Carex stantonensis, 5. 6. 7. 8.

Carex Elrodi n. sp. Spikelets 3-5, the terminal one all staminate or with a few fertile flowers at tip, not over 2.5 cm. long, about 2 mm. wide, sessile, the rest fertile, sessile (the lower short-peduncled and rarely on a long and filiform radical peduncle), shorter, all linear except the very short subterminal ones, 3 mm. wide, chestnut-colored, contiguous, appressed, compactly flowered. Perigynia oval, plano-convex with sharp sides, papillose, abrutly contracted at base to a short stipe and at tip to a short bidentate beak not over ¼ the whole, or reduced to a rudiment, lateral ribs prominent, faintly 1-2-ribbed on the face, mostly green, sometimes purplish above, closely appressed, 2 mm. long. Scales very broadly ovate, barely acute to cuspidate, dark-chestnut colored with broad and white hyaline edges, as long as the perigynia. Bracts very short and scale-like except the lowest which has a subulate and green tip 1-3 cm. long, sheathing with purple arricles, at least the lowest ones. Leaves all basal or nearly so, rarely 1 dm. long, 3-5 mm. wide, feeling smooth, but finely papillose, subulate acuminate, stiff, flat, splitting up into coarse chestnut-colored fibers below, sheaths slightly fibrillose, green. Stems obtusely angled, erect .5-1.5 ft. high, smooth, widely stoloniferous, narrow. This grows in dry meadows along with C. Parryana. Monida,, Montana. Middle Temperate life zone. This comes in the 3-stigma group with sessils perigynia and granular, and is related to C. Richardsoni. Dedicated to Prof. M. J. Elrod. Figured on P. 19 as Parryana var. Hallin.



Carex Parryana var. Statoni, 1, 2, 3.
Same, smaller specimen, 4. 5.
Carex Goodenovii var. dolia, 7, 8, 9, 10.

Carex Parryana var. Statoni Jones n. var. Spikelets 3-4, all sessile, congested into an ovate to oblong head, rusty, the terminal one 1.5-2 cm. long, the rest somewhat smaller to a third as long, all oblong, densely flowered, 3-6 mm. wide, appressed, the terminal one thickest. All wholly pistillate or with a few staminate at tip. Perigynia trigonous, rhomboidal obovate, the base with a substipitate spongy thickening, the tip triangularly contracted into narrow tip or beak not much longer than high, which is oblique, hyaline and notched, strongly 3-nerved with two on the sides and one on the inner face and all rounded and thickened, with 6-8 fine nerves on the outer face, granulated, 2 mm. long and 1 mm. wide and about half as thick, rusty colored. Scales ovate, acute, a little longer than the perigynia, rusty. Stigmas mostly two though frequently 3-stigma flowers are intermixed. Bracts all brown and scale-like, sheathing. Stems sharply-triangular, about 6 dm. high, erect but slender, leafy only near the base, stoloniferous, granulated but seeming smooth. Leaves 2-3 mm. wide, revolute, acuminate, about a third as long as the stems, papillose, with fibrillose sheaths, light-green. Growing in dry meadows. Deer Lodge Valley, Montana. The type collected at Ryan's ranch, Aug. 3rd, 1905. Dedicated to W. C. Staton of Anaconda. I also refer to this material got in the same valley in July, which is only 2 dm. high, with smaller spikes and scales, hardly as long as the perigynia, though having the same rusty color, with the light center and very narrow wihte edges of the type and the perigynia fully 2-3 times as thick as wide and like the type filled by the seed. This would seem to come near to C. Idahoa Bailey.

Carex Goodenovii var. dolia Jones n. var. Spikelets all on filiform peduncles, 2-10 mm. long, clustered in a deltoid head, 3-5, 5-15 mm. long and about 3 mm. wide, densely flowered, broadly linear, nearly black and with green perigynia, the terminal one with a few staminate flowers at the base and then clavate, or rarely at both tip and base. Perigynia broadly ovate, granulated, nerveless except the two lateral ones at the tip, plano-convex, 2 mm. long, green or flecked with purple above, sessile and with a spongy ring at base, filled by the seed, with a minute cylindrical beak not longer than high, appressed. Scales oblong, rounded and obtuse, black with light center, nearly as long as the perigynia. Bracts setaceous, green, with black auricles, the lower often 1 dm. long, sheathless. Stems filiform, 1.5-2 dm. high, nodding, obtusely angled, papillose as well as the leaves, densely caespitose, leafless except at very base. Leaves dark-green, 2-3 mm. wide, involute, shortly acuminate, about half as long as the stems, with hyaline nonfibrillose sheaths. Growing in dense mats above timber line at Sperry Glacier, Montana, in moist meadows. This evidently belongs in the C. Goodenovii group with two stigmas, and is nearest C. Goodenovii var. limnophila (Holm. as vulgaris var., Proc. Am. Acad. 17 307), but differs from that in the spongy base of the perigynia, nerveless, not sessile spikelets and narrower. It also differs fro mthe var. lipocarpa (Holm. Proc. Am. Acad. 17 308 as vulgaris var.) in the not stipitate and nerveless perigynia, granulated, clustered and short spikelets, etc. It differs still more from the var. hydrophila (Holm. l. c. as vulgaris var.) in the caespitose stems, granulated and not stipitate perigynia.

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